

# Aviation Week

and *Space Technology*

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A McGraw-Hill Publication

May 23, 1960

Space Medicine  
Probes Radiation,  
Weightlessness

Dassault Mirage IV







Official United States Navy Photograph

**Sparrow III Navy air-to-air missile is now operational with both the Sixth and Seventh Fleets. Raytheon is prime contractor for this potent weapon.**

RAYTHEON COMPANY, WALTHAM, MASS.



EXCELLENCE IN ELECTRONICS

## AVIATION CALENDAR

- May 25/26—CIVT Annual Convention** 1455  
For final Collection '65  
June 1—Hawthorn Annual Vantage Model  
ings Conference, New York University  
New York, N. Y.  
June 3—Bell-Hill National Manufacturers &  
Operators Meeting, Reading, Aviation  
Society, Reading, Pa.  
June 5—Semi-Annual Meeting and Area  
June Conference, American Society of  
Mechanical Engineers in Shafter Hotel, New  
York, N. Y.  
June 14/15—15th Meeting, Aviation Develop-  
ments and Manufacturers, New Orleans  
Hawthorn Hotel, Montreal, Canada  
June 15/17—1965 Blue Thunder and Final  
Maintenance Institute, Stanford, Union  
City, Stanford, Calif.  
June 22/24—1965 Conference on Stand-  
ards and Electronic Measurements, NBS  
Boulder Laboratories, Boulder, Colo. Co-  
sponsored Institute of Radio Engineers  
Professional Group on Instrumentation  
Radio Standards Laboratory, National Bu-  
reau of Standards, Summer Institute of  
Electrical Engineers, International Dy-  
namics  
June 22/25—1965 Annual Meeting Institute  
of Navigation, U. S. Air Force Academy,  
Colorado Springs, Colo.  
June 26/27—1—2nd Annual Meeting and  
Agendas Exhibit, Aerospace Society for  
Flying Machines, Chesham, Bedford  
HMO, Alden, Gt. B. I.  
June 27/28—Fourth National Convention on  
Military Electronics, Institute of Radio  
Engineers, Sheraton Park Hotel, Wash-  
ington, D. C.  
June 28/30—1—National Summer Meeting  
Scientists of the International Systems  
Association Hotel, Los Angeles, Calif.  
July 3—4—Fourth Annual Fort Wayne Na-  
tional Changeflags, (civilian aircraft,  
coast, airplane, navy) Fort Wayne, Ind.  
July 5/6—Special Session, Engineers in  
(Continued on page 5)

## EXPOSITION WEEK AND Space Technology

May 22, 1965  
Vol. 22, No. 21

Special week with an address and lecture series  
on space technology. The first lecture is by  
Dr. W. H. Rouse Ball, President of the Royal  
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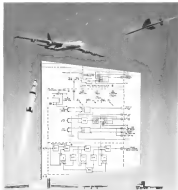
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AVIATION WEEK, May 25, 1965



## The Application of DATA PROCESSING TECHNIQUES

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4. Completely bonded all component parts by an exclusive process of curing and manufacturing to provide a ground-refueling hose that is not only strong and easy to handle, but the safest ever built.

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## AVIATION CALENDAR

- (Continued from page 5)
- what: Guidelines—Terrorist and Interplanetary Manoeuvre Institute of Technology, Cambridge, Mass.
  - July 31-32—Conference in Response of Metals to High Velocity Deformation, Stanford Hotel, Estes Park, Colo. Sponsored by Metallurgical Society of the Aeronautics Institute of Mining, Metallurgical, and Petroleum Engineers.
  - July 30-31—Liquid Rockets and Propellant Conference, American Rocket Society, Ohio State Building, Ohio State University, Columbus, Ohio.
  - July 30-31—Second Annual Symposium on Computers and Data Processing, Denver Research Institute, University of Denver, Stanley Hotel, Estes Park, Colo.
  - Aug. 1-3—Fourth Global Communications Symposium, Butler Hotel, Washington, D.C. Sponsored by Institute of Radio Engineers, U. S. Army Signal Corps.
  - Aug. 2-11—17th Annual U. S. National Seismic Symposium, Estes County Airport, Estes Park, Colo.
  - Aug. 3-11—Western National Meeting, American Astronautical Society, Olympic Hotel, Seattle, Wash.
  - Aug. 8-13-1963 Pacific General Meeting, Astronautical Institute of Electronic Engineers, El Centro Hotel, San Diego, Calif.
  - Aug. 10-13-1963 Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.
  - Aug. 10-19—Electronic Packaging Symposium, University of Colorado, Boulder, Colo.
  - Aug. 20-25-1963 Corporate Engineering Conference, University of Colorado, Boulder, Colo.
  - Aug. 27-28—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.
  - Aug. 28-Sept. 6-1963 National Air Traffic Management Design, West Coast Air National Aeronautics Assn.
  - Sept. 4-6—Civilian, Chord-Center Airport, Akron, Lakeland Airport, Cleveland, Ohio.
  - Sept. 5-11-1963 Penetration Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.
  - Sept. 22-26-1963 Annual General Meeting, IATA, Copenhagen, Denmark.
  - Sept. 30-31—Second International Congress, International Council of the Aeronautical Sciences, Zurich, Switzerland.
  - Sept. 10-14—Naval Warfare, National Navy of State Academy, Norfolk, Wash. D.C.
  - Sept. 15-16-1963 Annual Meeting, Aeronautical Engineers, American Rocket Society, Sheraton Park Hotel, Washington, D.C.
  - Sept. 19-21—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, Stanford Hotel, Washington, D.C.
  - Sept. 21-25—National Conference and Symposium, Aerospace, Air Force Assn., Crow Addition and Bristol Hall, San Francisco, Calif.
  - Sept. 27-30—Power Systems Conference, American Rocket Society, Maxwell Hotel, Santa Monica, Calif. Cosponsored by U.S. Army, U.S. Navy, National Aeronautics and Space Administration, Aeronautical Engineering Council.

## From General Motors . . . Temperatures Made to Order

# HIGH-LEVEL TRAVEL DEMANDS SAFE-LEVEL TEMPERATURES

**NEW AERO COMMANDER 300  
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GUARD ENGINE TEMPERATURES**

Going up . . . and getting down to business! It's the new Aero Commander 300, the ideal way for the modern businessman to travel. This sleek, ultra-modern executive transport is fleet, maneuverable and comfortable. And Harrison oil coolers get the job to maintain safe, steady engine temperatures. Guarding vital operating temperatures on today's advanced aircraft is a Harrison specialty. It requires the engineering skill, long experience in the best-in-the-field and the research facilities that back every Harrison product. So, if you have a cooling problem, rely on Harrison for the answer.



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HARRISON RADIATOR DIVISION, GENERAL MOTORS CORPORATION, LOCKPORT, NEW YORK



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## TEST RADOMES TO MIL-R-7705A (ASG)

- including type II radomes • automatic recording of bore-sight error with overall system accuracy of  $\pm 6.1$  milliradian ( $\pm 0.35^\circ$ )

The effectiveness of the best airborne radar tracking system can be completely destroyed by deflection of the radar beam as it passes through the plastic radome. Now, for the first time, radome manufacturers and service firms handling radomes can be completely assured of radome quality. CTE Automatic Radome Bore-sight Error Measuring System replaces tedious spot checking with a continuous recording of beam shift across radomes.

In the system shown above, as the motor-driven holding fixture rotates the radome under test, the servo-controlled null-seeking antennas on the boom trace the position of the deflected radar beam. At the control console, which provides single point control of the entire system, three recorders plot the total magnitude and horizontal and vertical components of the beam deflection angle directly in milliradians. Rate of change of beam deflection, essential to accurate applications, is readily obtainable from the recordings.

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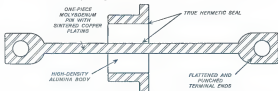
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CITY \_\_\_\_\_ STATE \_\_\_\_\_





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**Honeywell Dynamic Analyzer recreates authentic  
shoot environment, pinpoints design deficiencies**

The Honeywell Dynamic Analyzer will simulate actual flight conditions from sea level to extremely high altitudes which affect performance and stability of aerospace systems. An integrated test facility, it brings together for the first time most of the conditions and phenomena that cause aerospace system breakdowns.

*It will be interpreted of the weather, the availability of test vehicles and flight variables. And in many cases, the test data will be more reliable and valid than can be obtained in flight testing.*

Areas of application include: reconnaissance, guidance, power supply, and communication systems. Tests of complex systems which now might require more than a year to accomplish, will be re-arranged down to several weeks. It will be possible to determine which operat-

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The first Dynamic Analyzer was conceived under the direction of the Aerial Reconnaissance Laboratory of the Wright Air Development Division, USAF. Thus, the fully instrumented analyzer will be housed in its own building. Capabilities include high vacuum, high and low temperatures, three-dimensional vibration, roll, pitch and yaw motion, buffeting, resonance, target variations, controlled ground speed, reflected and transmitted signals.

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**H** Military Products Group



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You could be a "dash five" attacker out to execute a low-level mission on a "dash five" war. You could be a stratosphere bombardier assigned to retaliation in a full-scale nuclear conflict irrespective of radar contact, your aircraft would be electronically engaged to attack a target obscured by "smoking zero" weather. Or with the A2V's highly accurate navigational system, you could be pin-pointing defenses for intelligence

But this for certain, you would have the ability to operate from either a carrier deck or a tactical base where. You would be able to strike selectively from any altitude—any altitude—and in any visibility day or night. You would have the versatility to choose your weapons before take-off—the flexibility to choose the best possible attack method at the last possible moment.

This would be your mission: day-mission, drop-places. Which is, even better, fully integrated bomb-see system. They call it **YAG-100**, now in flight evaluation by the Navy. Conceived and developed by...

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- proportional temperature controlled warm-up feature sensitive to eliminate about 50 watt and electrical shock

Complete system in one small package. No external transformers, resistors or radio noise suppression needed. Minimum adjustment of power taps and portable windshield installation. Dramatically reduces windshield thermal and electrical shock.

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Control power	100W at 115V
Rated operating temperature	-50° to 100°
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Output voltage	0 to 100V
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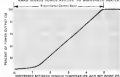


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MUCH!**

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Example? StratoPower's production model 1.1 cubic inch motor weighs only 1.8 pounds. But you can pour

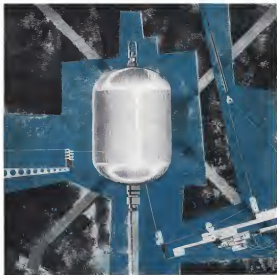
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Tell us about your requirements.

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Thermal stability is a must...to withstand the changing temperatures resulting from high speeds, burn cycles and jet exhausts. And VIBRIN 135-A is one of only two resins which have met the Military Specifications (M-23042) for such applications. (The other is resin 135.)

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SPACE TECHNOLOGY LABORATORIES, INC.

## Fall-Out From the U-2

Last week we warned that the extraordinary attacks on Secretary of State Dexter and President Eisenhower marking aerial espionage and violation of foreign airspace with the Lockheed U-2 as official U.S. policy would produce serious repercussions in the future. The persons paying these words had hardly stopped ringing when the first diplomatic fallout from these incredible statements began coming down. At this writing it is still raining with no prospect of early abatement.

One of the extremely harmful effects of these statements has been the embarrassing position in which we have placed our allies on the edge of the Iron Curtain. In those states, such as this country, formerly implicated there is an official espionage effort against the Soviet Union and provided the Communists with arms, potent ammunition against the NATO countries that they themselves have been able to generate on a steady basis. The growth of this third position is indicated in the formal diplomatic protests already lodged with the U.S. by Norway and Portugal and the command of Soviet threats to withdraw these allied bases if any further U.S. operations are conducted from there. Denmark finds it necessary to make an official statement denying its ability for unauthorized flights over countries not members of NATO. It is hard for people in this country to realize the damage being done to us on the edge of the Iron Curtain to stand still behind our crime in the face of the constantly growing Soviet military, threat, economic and cultural exploitation and diplomatic pressure. Norway and Denmark, by their own policies, as the NATO organization provide proof positive of the free world's determination to resist Soviet aggression. Both these countries use their monthly shipments by Non-Communist in World War II bond under a deposit acquisition and needed it with our arms at their disposal. Thus have learned that there can be no compromise with brutal aggression on either side without label it bears. Norway has a common border with the USSR. Denmark sits on the shores of the Baltic sea, generally a Germanic bloc, and is flanked by Communist Germany to the Southwest. Both have stood firm in the face of earlier Soviet threats against their NATO role.

Both of these countries have made total contributions not only to NATO's strength but to the overall U.S. role here position in the Western world. Norway's underground activities saved lives as early northern route are practically impossible to destruction even by nuclear weapons. The giant tank on the North Cape looks down into the belly of Soviet air activity on the Kola Peninsula and across an Arctic Sea. The Danish role on Bomberland Island in the Baltic does a similar job on the Caucasian peninsula from Leningrad to East Germany. The net of law is based in Greenland along with the BMEWS site is another total Danish contribution. Both Norway and Denmark residents still live modern yet and provide forces at considerable cost to them. These isolated national economies to look their determination to remain free and to their own flag.

Now we have revealed the levels and courage in people pulling the rug from under their exposed positions and providing the Soviets with the only solid evidence for diplomatic protest in a decade of scolding. Turkey, which has an inherent sympathy to the army of Moscow regardless toward NATO and has been behind the campaign to fight the war between light of the western collapse and the policies when they threaten has made similarly important contributions to NATO and is now left in a similarly embarrassing position.

The next chapter in this unnecessary humiliation of our allies and our effect will be staged in the past world sounding board of the United Nations. It is difficult to see it this time how a successful public defense can be made for our right to unilaterally prosecute other nations' airspace for the purpose of espionage. No matter how apologetic look privately about this action it will be difficult if not impossible, for our allies to formally support such a position in an international forum.

But even worse than the position in which some of our allies find themselves because of our handling of the U-2 situation is the moral and thoughtful manner in which our ally's position is being handled. The response under the U-2 has been contracted and steady, deliberate international position in relation to the Soviet Union. We cannot hope to retain the leadership of the free world unless we conduct it with unswerving moral intelligence, skill and effective means that has been displayed in the U-2 incident.

The behind-the-scenes work by President Eisenhower that he had suspended U-2 flights for the duration of his administration, since too late to do much good at the moment and it continued will have this country in a position of being so charged over the Soviet Union at a time which we would have to admit it is little doubt that the temperature of the cold war is rising. And the knowledge that no going U-2 missions will be running the Soviet impact certainly under the prospect for surprise military action were sweeping this over to Soviet leaders.

As predicted, President Eisenhower's assumption of responsibility for the U-2 flights ended the door on the curtain provided his law in Khrushchev's original intention of the incident and left the Soviet leader no further room for maneuver. It obviously tried to suggest the U-2 episode into a far larger case than originally intended, it only to push a wrong side of domestic discussion.

Collapsing of the curtain was based on warhead threat far deeper than the U-2 flights although the official U.S. handling of this episode provided Khrushchev, with an unusually convenient escape hatch and an extremely fair opportunity to believe equally well for both conventional and Russian concepts.

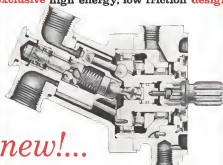
Perhaps the real value to this country of the very summit spectacle is that the critical mass of friendship shifted from Soviet leadership, revealing its true nature and the fact that its goals have not changed one iota since the day of Stalin's death. Mr. Khrushchev's bested threat to the West of "peaceful coexistence or war" and his good-sounding behavior should make it abundantly clear that he "peaceful coexistence" the Soviet leadership means peace in their terms with the usual threat of war to force compliance.

The spectacle of the summit should convince the American people that the best position of opposing Soviet imperialism has not changed one iota during the recent "peace talks" even when the country's official policy was to pursue peace without deferring the price we were being asked to pay.

It is worthwhile now to recall that there are many American leaders who worked against allowing U.S. policy on the basis of this false front of Soviet smiles and who steadily maintained that our best position for any negotiation would be a position of moral/legal/moral strength. In the historic light of the western collapse and the policies that "peaceful" stood for, the American people must think unsway in which type of leadership they should look to for future guidance.

—Robert Hald

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## WHO'S WHERE

### In the Front Office

Oliver J. Strohman, assistant vice president in charge of Air America, United Aircraft, Cadillac, Mustang, Range, Daimler, or Cape Canaveral, Fla.

Brace McKay, assistant vice president in charge, Bell Aircraft Corp., Kansas City, Mo.

Robert J. Kelle, president, Pacific Air Corp., Portland, Ore., succeeding John W. Moore, who resigned as head of the company and its various offices.

Frederick P. Dwyer, vice president and director of engineering, DeSoto Products Corp., Dayton, Ohio, succeeding John T. Hennessey, who resigned as vice president of the company.

Dr. Charles R. Bowers, vice president and director of research and development, Raytheon Company, Lexington, Mass., succeeding J. C. Sullivan, who resigned as vice president and director of engineering.

J. Alan Russell, vice president and general manager, General Electric, Springfield, Mass., succeeding J. J. Graham, who resigned as vice president and general manager of the company.

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## INDUSTRY OBSERVER

►Nuclear, 650th, autonomous unit, which National Aeronautics and Space Administration will develop as a successor to Titan, is scheduled for initial launch into a polar orbit within approximately two years. Nuclear will be attached to the Titan, which will be the first instrument to be launched toward the earth, rather than being launched as was Titan to increase the amount of usable data collected in each pass.

►Plans for a theoretical and experimental program to determine the nature and extent of airframe cross-sections to be used and the feasibility of active and passive countermeasures to mitigate the threat have been requested by Navy's Bureau of Weapons for Fiscal 1961.

►Project Dazzle is a Rand Corp. study aimed at a long-range assessment of what could be used in an airborne command system. Study concerns state of the art in chemical propulsion, autoguided navigation, low-level control and other techniques that could give an aircraft extended flight time.

►Detroit Army Arsenal has set a July 1 deadline on Yale for a feasibility study of a mobile defense system. The study would determine whether a mobile defense system (AW Apr. 25, p. 21). Potential buyers are now looking up at its effect on the world for what may be the largest Army air defense system in the past 50 years period. General Electric Division and General Electric Division Systems Department are submitting one joint bid.

►Comet III vehicle is ARPA-Air Force Signal Corps delivered against missile system is presently scheduled for launch on Sept. 1.

►First full thrust tests of the complete Rocketdyne F-1 5-funnel thrust engine are scheduled for next spring at the Rocket Engine Test Station, Edwards AFB, Calif.

►Additional ground stations for the Space photograph-electronic reconnaissance satellite are planned for New Hampshire, Los Angeles and Oregon. During research and development phase, Space will make maximum use of modified DeWitt tracking and acquisition stations.

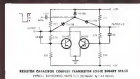
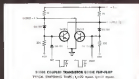
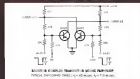
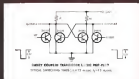
►American Bosch Arma Corp. has set up an office in Los Angeles to develop the design of a new type of engine. Previous efforts have been made difficult because of requirements concerning Bosch's German ownership that all state-owned companies be U.S. citizens. American Bosch Arma negotiated with Northrop over an engine two years ago and recently had been talking with Bell Aircraft Corp., whose design interests have since been acquired by Textron (AW Apr. 25, p. 31).

►Engineering design of the General Electric engine which is under development and the Pratt & Whitney XLR 115-1 liquid hydrogen rocket engine has been held at its development test facility at a number of times. Space was a XLR 115 test at 11,000 lb. thrust each in static vacuum and in controlled air flow tests at 10,000 lb. thrust each.

►Cost of each Constant stage, exclusive of development costs, ground support equipment, transportation, handling, etc., is estimated by National Aeronautics and Space Administration at \$7.5 million. The first stage for the Atlas booster is \$4.5 million; the Thor-Agena, \$1.4 million; for Thor-Delta, \$2.6 million. Scout, which originally was expected to cost less than \$900,000 per vehicle, is now estimated at \$750,000 each. Figures do not include costs of payloads to be boosted by these vehicles.

►Four Northrop T-38 Talon supersonic jet trainers now being tested have made approximately 750 flights, and the first N-150 "Freedom Fighters" has made more than 50 flights. A second N-150 was recently delivered to Edwards AFB, Calif. Latest two T-38s, which have aluminum fitted to the two General Electric Y84GE-3 turbojets, have attained Mach 1.25 in shallow dives. J-57-G engines for production versions will deliver 3,500 lb. thrust. General Electric has received a J-57 for its flight test program.

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## Washington Roundup

### ARDC-AMC Debate

USAF Air Staff is split about evenly on deciding whether to shift some AMC procurement functions to ARDC. After a split vote, Air Staff decided to call for additional study of the proposal.

Proposal was made by ARDC Commander Lt. Gen. Bernard A. Schriener. Schriener states that the development phase of present and future weapons systems extends far into their operational life. And there are relatively few systems planned to large numbers now. Schriener feels it would be more efficient to merge their procurement to ARDC under these conditions.

The move is strongly opposed by AMC Commander Gen. Samuel E. Anderson. AMC feels it would be relegated to a routine maintenance type supply function.

Bigger defense budget for Fiscal 1961 seems an inevitable result of the collapse of the Paris summit conference. Joint Chiefs of Staff are warning U.S. defense policy Administrators will be subjected to attack as policy is implemented by a hot iron in international relations, but both cold war tensions will make it difficult to turn down any U.S. disarmament efforts.

However, future will aid efforts of congressional supporters of more defense spending. A modest increase in the budget was in prospect before the current incident. There was Senate support for budget changes even before the Paris crisis. Senate leaders generally accept the situation made by the House on the Administration's budget but they also want to make some changes of their own.

There were indications last week that the Senate Appropriations Committee would provide means for development of the B-70 as a complete weapons system. This would expand the House-approved Administration request for prototype aircraft development funds.

Additional spare parts and personnel funds for an expanded airborne alert capability are expected from the Senate group. More development and procurement money for Air Force Atlas, Titan and Minuteman programs also is a good prospect.

Reduction of the \$480.5 million House cut in general procurement funds is expected. So is restoration of a specific House cut of \$125 million in Army procurement funds, and there is a chance these funds will be recovered. Reduction of House cuts amounting to \$85.5 million for operations and maintenance, \$54.5 million for communications facilities, \$51.6 million for administrative personnel and \$71.1 million for travel also is expected.

Little Senate support is expected for Administration request that funds be set aside for a constitutional amendment and for the Tennessee strike.

### FAA Wartime Status

Administration is asking for authority to make the Federal Aviation Agency an adjunct of the Defense Department in wartime. Sen. Warren Magnuson has introduced an Administration bill that would make the FAA administrator directly responsible to the Defense Secretary in a war.

USAF Maj. Gen. Harold W. Gantt is a leading contender for the job of running the new Defense Communications Agency. The group will take over general communications facilities and functions now the province of the individual services, including operational mission control systems. Gen. Gantt is now director of Air Force Communications Electronics.

Chief of an Air Force office for the job would prefer USAF objectives that the post organization represents an expansion more by Arac Sigel Cohen. There is a counter opinion that the job should go to an Army man because an Air Force official, Maj. Gen. Donald N. Yates, was named to head the last post organization formed—Defense Department's missile and space range coordination office.

### NASA Bio-Med Plans

NASA expects to have plans for its Life Sciences Research Center ready to present to Congress and spending. Dr. Clark R. Burt, director of NASA's Office of Life Sciences, is currently looking for an assistant director to plan the center and jointly it to Congress. Tasking will cover about \$100,000 a year, a maximum professional staff of 10.

Dr. Freeman H. Quinlan, who has been named assistant director for grants and contracts, is one whom 75% of the life sciences budget will be spent. Dr. Quinlan is a former Chief of Naval Research Institute who has run the life sciences effort in Army's Research and Development Command for the past year. Other assistant directors are Dr. C. A. Tobias, for biochemistry, and Alfred M. Miles for biophysics.

Activities committees are being formed to coordinate with the House Veterans in the research center. Dr. Randolph Linsdale will head the flight medicine and biology committee; a vice chairman of the council. Medical advisory committee. Dr. Malva Calver of the University of California, will head the space biology committee. No chairman has been chosen for the space medicine and behavioral science committee.

—Washington Staff

# Joint Chiefs Evaluating Defense Program

Paris summit crisis sparks military policy review; Douglas asks restoration of carrier, Bomarc funds.

By Katherine Johnson

Washington—Joint Chiefs of Staff are re-evaluating the U.S. defense program as a result of the Paris summit crisis.

Deputy Secretary of Defense James H. Douglas told the Senate Armed Services Subcommittee last week that the Fiscal 1961 program will have to be seriously reviewed and evaluated. Douglas' state of the Joint Chiefs Committee is Sen. Richard Russell (D-Ga.), chairman of the Armed Services Committee and a member of the Appropriations Committee, that the U.S. "does not have a position of strength and the President did not have it in Paris." Douglas, however, asserted that "the President went to Paris with a strong defense position." Russell replied that "the strength was not sufficient to cause Mr. [Soviet Premier Nikita] Khrushchev to concede the usual courtesy of diplomacy. The President, a symbol of the United States, was publicly humiliated."

Meanwhile, airplane industry stocks, whose prices have been depressed for almost a year, started sharply in the summer breakup. Quick gains of two to eight points were recorded by seven companies, including Boeing, Douglas Aircraft Co., Douglas Aircraft Co., General Dynamics Corp., North American Aviation, the Martin Co., McDonnell Aircraft Corp. and United Aircraft Corp.

Generally, Douglas opposed House changes in the House Committee on the Fiscal 1961 budget (AW May 9, p. 18), which was submitted in January and voted in April, at least until completion of the Joint Chiefs' recommendations. However, he did support House allocation of some funds for modernization of USAF's Military Air Transport Service—\$150 million of the \$150 million allocated by the House for procurement of 100 C-119s, KC-119s, KC-119s, or similar aircraft, for MATS.

The two major objections made by the House which Douglas preferred were:

• **Bomarc B**—an defense missile for Air Force. The House's action in canceling the operational program for the Bomarc B, Douglas declared, was "an most serious" and "would leave a serious gap" in the defense program "which could not be filled either quantitatively or qualitatively in the same time period" with interceptors.

The House eliminated \$48.4 million in Fiscal 1961 funds and \$253.6 million in funds from future years which USAF wants to complete 10 Bomarc B squadrons, including two squadrons for Canada. In April, Air Force leaders sharply reduced the program from 16 squadrons to 10, reducing the original budget request by \$100 million. The House approved \$50 million for continued testing of Bomarc B.

It, pointing out that the initial P-56 delivery could not be effected until more than a year after the planned initial deployment of the Bomarc B.

• **Continued increased aircraft carrier** for Navy. Douglas urged the subcommittee to restore \$79.5 million eliminated by the House for the attack carrier, emphasizing its role in limited war situations. He said the Fleet's attack carrier will be needed by 1965 to replace four Essex-class carriers, which will then be over 20 years of age and no longer capable of performing an attack carrier role.

Navy's 11 attack carrier force is now composed of four Forrestal-class fast attack carriers and seven Essex-class ships. Three Forrestal-class carriers now being built—including the newest-powered Enterprise—will replace three of the Essex-class ships by the end of 1962.

## Other Highlights

Here are other highlights of Douglas' presentation:

• **Space satellites**. Douglas said a \$44 million amount voted by the House for the Atlas missile warning satellite, Seasat communications system and the Discoverer experimental satellite is not necessary because, if additional funds are needed during the year, they can be drawn from Defense Department's emergency fund.

• **Missile and rocket development**. Douglas said the Defense Department should not attempt that the \$157.5 million added by the House to push this program would be needed and recommended that it be eliminated.

• **Ballistic missile**. Douglas said the subcommittee to restore \$240 million added by the House—increasing \$18 million for Navy's Polaris fleet ballistic missile for this program. The House program provides for fast loading of the Polaris missiles and their supplies plus the purchase of long-range fleet for seven submarines in Fiscal 1961. The Administration's request is for fast loading of these submarines and procurement of long-range fleet for six.

• **Anti-submarine warfare**. Douglas agreed to \$41.9 million of a \$100 million House increase in funds for anti-submarine warfare, aircraft and development. This would bring the Fiscal 1961 allocation to \$213 million—\$23.1 million over the Fiscal 1960 allocation.

• **Airborne alert for Strategic Air Command**. Douglas said that the Defense Department's program for an airborne alert capability for one-fourth of SAC's heavy bomber force and asked the sub-

committee to delay a \$113 million addition by the House for a compromise capability between the Department plan and that adopted by SAC command. Gen. Thomas S. Power, but an airborne alert capability for one-third the heavy bomber fleet.

Douglas noted that the defense budget passed by the House gives the President authority to incur all expenses essential for an emergency on home alert. Including the \$85 million in the Fiscal 1961 budget. Douglas said USAF has programmed a grand total of \$750 million for the defense alert including \$40 million in operations and maintenance funds and stocks on hand transferred to the program.

• **Army modernization**. Douglas agreed to a \$17.5 million increase in power plant funds for Army modernization but objected to the method for financing the remainder of a \$237 million increase provided by the House—from non-maintenance funds into sales of the federal security program and from savings derived on contract costs.

• **Contract management**. Douglas strongly protested an across-the-board 5% cutback by the House in all procurement contracts in a move to force Defense Department to drive better contract language. The reduction would total over \$400 million.

• **Administrative overhead**. As an alternative to the \$33 million 10% reduction made by the House in all department administrative costs, Douglas proposed a \$10 million 5% reduction in the originally planned June 30, 1961 civilian and military personnel strength for all administrative-type headquarters and research centers. But Gen. Douglas said that the budget presented in January already reflected an average reduction of 10% in military and civilian administrative personnel for USAF.

## Nike Zeus Funds

Washington—Army hopes to transfer \$18 million in Fiscal 1961 funds to accelerate production techniques for Nike Zeus anti-aircraft missile systems.

Richard S. Munn, Army director of research and development, said that some present plans, the funds will be used for production of new automatic processes for development of missile type hardware, process control and other Zeus components "which require an extensive degree of reliability and ultimately will be required in large quantities."

The funds are now being transferred from the Army to the Defense Research and Emergency Fund. Defense Department, at that, will request Bureau of Budget approval to transfer the funds to Army's research, development test and evaluation appropriations.

BEFORE LAUNCHING of the new Soviet satellite was disclosed in this photo taken by Cosmonaut cosmo drone on a 90 sec. ground. Viewed under a magnifying glass, the satellite shows all down a strong embossed track and the second stage at bottom left shows an asymmetrical structure in addition. Three in from southwest (bottom left) to southeast (top right).

## Space Technology

## Life Support Systems for Space Tested in New Soviet Satellite

By Ebert Clark

Washington—First test flight of the Soviet spacecraft launched by the Soviet Union on May 15 was aimed primarily at testing the support systems that will allow a man or men to exist outside the earth's atmosphere on their own space according to Russian sources.

Soviet broadcast in Rumania and the craft carried "a load equivalent to the weight of a human being," while Soviet radio engineers broadcast said it carried a "human astronaut."

Some Western scientists speculated that this first test carried a man alone because model is a standard risk if he was, enhanced safety to earth.

But comments by Soviet scientists indicated that this is merely the first of a series of unmanned tests, that the problem of life-support has not yet been solved and would not be, as reported on May 15th flight, and that the launch of the first manned craft will be months away—although one Russian scientist said it "perhaps" will occur this year.

In late last week, Russia said the end of the satellite's flight was imminent. U.S. tracking indicated the space had

been ascended to 418.5 mi. and perage to 185 mi., which would have required firing of a rocket while in orbit and would have put the satellite into the lower Van Allen radiation belt.

The two-pair spacecraft weighed 16,000 lb. and contained a pressurized, heat-regulated oxygen system weighing about 5,512 lb. and an environment compartment containing some 1,250 lb. of environmental plus chemical and solid hardware. The cabin was to detach from the instrument compartment on radio signal from the earth and both were to burn on re-entry. Soviet scientists said.

The spacecraft was launched at approximately 1 p.m. Moscow time on May 15 the second anniversary of the launching of Sputnik III at an altitude of 65 mi. to the equator.

The orbit was the most earth-closer of any Soviet satellite launched thus far—with an apogee of 723 mi. and a perigee of 194 mi. Orbital period is 92.2 min. Soviet Russian scientists termed to the "most powerful" Soviet rocket tested last January (AW Jan. 19, p. 27) on discussing this launching, although some specifically said that the Soviet rocket was used.

The spacecraft carried a "signal" radio transmitter operating on 10.995



# Policy Weakness Laid to Lack of Debate

Washington—National Security Council's policy weakness is its failure to fully debate new and controversial matters in order to create policy lines designed in respect of changing world situations. Dr. James A. Perkins, vice president of the Carnegie Corp., charged during closed hearings of the Senate Subcommittee on National Policy-Making.

Perkins, a member of the Gusher Committee which was appointed in 1957 to survey national security problems, told the subcommittee the National Security Council system is "not built to permit use of the increasingly new idea to filter five-run-up access personnel and finally reported" to the President in drawing on such policies. He added:

"It would say that it has been at its best when it has to do with matters that came within fairly well established guidelines, both in terms of budget and in terms of established situations and it has been at its weakest when matters are extremely controversial and break into new ground in that regard more matters of policy."

The Perkins told the subcommittee that President has not received from the recent National Security Council course "the kind of sharp debate, the clear definition of options, the aim clear that could require some modification of programs."

The Perkins did not touch as to the nature of the Gusher Report on national security needs, which is still delayed by the Administration, but

said that when the committee began its review "it seemed to us that the nature of the threat was not fully determined or fully considered... as a matter of fact, I said there and I say again that whatever words of wisdom we may have put into that document would have largely been wasted if the Russians had not so fully complied by sending up a missile and then looking at what that was, in a satellite, and another one more weeks afterward. We may well be shocked."

In another set of hearings before the same group, senators told Sen. Henry M. Jackson (D-Wash.) subcommittee chairman that revision and clarification of the "conflict of interest" statute are required.

Rene B. Perkins, chairman of the New York City Bar Association's national committee on the federal conflict of interest law, called for "a careful analysis" where that effectively actualized official conflicts of interest without generating personal side effects on the committee.

The association's report arrived in the form of a bill introduced by Sen. Kenneth Keating and Joseph K. Levin, both New York Republicans and William French (D-Wash.) should resolve the conflict of interest statute.

Recommendations made by the association include:

- "The present authorized and unauthorized statutes relating to conflicts of interest should be consolidated into a single unified act."
- "The statute should prevent the retention by government employees of certain security-related economic activities, such as continued participation in private pension plans."
- "The interests contained in the present statute should be greatly expanded so that scope by making them applicable to members of all markets in which the public deals with the modern federal government."

When B. Perkins director of that was Reidel, Co. and the former Secretary of the Education and Welfare made the following suggestions:

- "A central agency in the White House should monitor both of personnel and the necessary qualifications, recent people, place their property and support them in the various features of government administration."
- "The retirement salaries of these top grades of Civil Service should be reviewed."

• "A more extensive management development program should be adopted throughout government to identify and develop the most promising younger people."

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First Photo of BMEWS Greenland Site

First Satellite Photo Early Warning System (BMEWS) site at Thule, Greenland, taken to give into operation this fall. Satellite photo shows the site. Buildings are located in buildings immediately behind the site. Also shown is two radar dome-like structures (1), a control center building (2) and several buildings (3), (4), (5), (6), (7), (8), (9), (10), (11), (12), (13), (14), (15), (16), (17), (18), (19), (20), (21), (22), (23), (24), (25), (26), (27), (28), (29), (30), (31), (32), (33), (34), (35), (36), (37), (38), (39), (40), (41), (42), (43), (44), (45), (46), (47), (48), (49), (50), (51), (52), (53), (54), (55), (56), (57), (58), (59), (60), (61), (62), (63), (64), (65), (66), (67), (68), (69), (70), (71), (72), (73), (74), (75), (76), (77), (78), (79), (80), (81), (82), (83), (84), (85), (86), (87), (88), (89), (90), (91), (92), (93), (94), (95), (96), (97), (98), (99), (100), (101), (102), (103), (104), (105), (106), (107), (108), (109), (110), (111), (112), (113), (114), (115), (116), (117), (118), (119), (120), (121), (122), (123), (124), (125), (126), (127), (128), (129), (130), (131), (132), (133), (134), (135), (136), (137), (138), (139), (140), (141), (142), (143), (144), (145), 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# Low Volatility Fuel Used in U-2 Lightweight



**LOCKHEED U-2's** drooping, flexible, high aspect ratio wing is an indication that the aircraft's structure is stressed for a maximum speed of about 200 mph or less at sea level. At cruise altitude of about 90,000 ft where the air density is low, the aircraft can fly at the neighborhood of 500 mph without exceeding the design loads. Viable results of this cruise speed is around 5-7. Moderate altitude is reached when the aircraft flies into its "infinite cruise" and begins to stall because of low air density at the same time that it has reached its critical Mach number (about Mach 0.75) and its drag is increasing as airspeed rapidly. While the U-2 was designed primarily to cruise at the highest possible altitude, the single performance objective also pays off in the high performance of about 500 mph and long range because of low drag in the thin air near 90,000 ft altitude.



**WHITE SULPHUR** has been placed into the pilot's custody as the U-2 to protect him during the hours he spends near 100,000 ft where most of the earth's atmosphere is below him. Long history of the U-2 has a high thrust ratio of nearly 10:1 but its fuselage diameter of about 4 ft is in the present action is sufficient to allow the use of a wide variety of large and low altitude. Result both these benefits cockpit layout has for Focke-Altair Model 101 prototype version (AW Sept 16, 1957, p. 78). General Aerospace 710 and fuel length required by Kerosene does not fit the Focke-Altair equipment, however.



**ALTITUDE PERFORMANCE** of the U-2, which is essentially a personal airplane, is achieved primarily through a light structure and a very low wing loading. Wing loading of the original U-2, which was designed using 1954 state of the art, was approximately 25 psf. Several versions of the U-2 have been built and a number of improvements have been incorporated into the second in the past few years. One of these was the replacement of the original Pratt & Whitney J75 with the Pratt & Whitney J75P-13.

## J75 Engine

By J. S. Bates, Jr.

Washington-Spanish refuel. Low use with a high boiling point apparently was used to fuel the Lockheed U-2 reconnaissance plane last near Stockholm, Russia (AW May 14, p. 28) in large quantities before low during high altitude cruise.

Instructions stored on the U-2's cockpit indicated in Moscow's Coast Post, so the aircraft should be filled with MIL-E-25224A fuel which is purchased in small lots under Air Force contract specifications for use in the U-2. Specifications for the fuel calls for a boiling point of 100° at sea level which is about double that of normal jet fuels. Otherwise, the U-2 fuel must resemble current turbine fuels.

The high boiling point and low volatility of the U-2 fuel is essential for good range performance, and low fuel evaporation during high altitude flights lasting several hours. Evaporation losses of J75-A is very high at the low static pressure pressures above 70,000 ft.

Minor performance penalties accepted with the low volatility fuel is a point altitude control capability within the aircraft is fitted with a specially-designed control system. U-2 fuel over Russia was forced to descend from its operational altitude of approximately 90,000 ft after an engine failure.

Specifications for the U-2 fuel were developed at the Wright Air Development Division of the Air Research and Development Command several years ago. Present supplier of the fuel, which has a narrow distillation range and can only be made from a few grades of atmospherically-distilled petroleum cuts, are the Ashland Oil and Refining Co., Ashland, Ky., and the Howell Refining Co., San Antonio, Tex.

Original Pratt & Whitney J75 engine in the U-2 was replaced by a more powerful J75P-13 in the aircraft last near Russia. This member of the J75 was specifically intended for the U-2.

According to Soviet sources, it weighs about 4,550 lb., which is about the same weight as the JT4A-18, a civil version of the J75 which delivers 16,800 lb. thrust at sea level. Military versions of the J75 weigh about 1,000 lb. more than this engine and deliver about 25,000 lb. thrust with afterburners.

Special features of the J75P-13 in the U-2 include a modified fuel control system to allow for the special fuel, which is denser than fuel ordinarily used in the J75, and a new, powerful aquiline system for starting because of low volatility of special U-2 fuel.

Reconnaissance gear and cockpit navigation equipment aboard the U-2



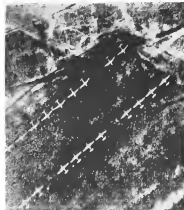
**BADLY DAMAGED** and twisted pilot's cockpit seat from the Lockheed U-2 is shown in the foreground above. The cockpit crump just behind the cockpit and still has a large section of Plexiglas intact and its frame is only slightly twisted.



**RIGHT WING** of the U-2 has several large holes in its upper surface, and its trailing edge has been broken off. Stiffer fuel tank in wing is at left in photo. Both wings apparently were damaged at the fuelage when the U-2 struck the ground.



U-2 PILOT'S high-altitude partial pressure suit, helmet, helmet oxygen regulator and pressure chute were exhibited in Moscow after the U.S. aircraft was downed at Sverdlovsk.



ANOTHER SOVIET SHOWBOY is the picture White Thunderbolt displayed before the President of the Supreme Soviet in Moscow claiming it came from the U-2 crash site in Fozzies Forest flight. This picture is actually of a training field near Riga some 800 mi. from the nearest point of Fozzies flight route as tracked by the Russian radar. Aircraft on the field are four engines Tu-4 bombers, a copy of the Boeing B-29. This type bomber has not been in front line service with the Red Air Force for many years.

deployed in Moscow was mostly standard military use and not of special merchandise. Much of the equipment and the U-2 structure displayed in Gorki Park was in relatively good condition, indicating that the wreck did not disintegrate in the air during its descent over Sverdlovsk and that its impact with the ground was relatively easy.

The reconnoitering and reconnaissance equipment included:

- Sensitive "Recon" receiver for electromagnetic reconnaissance to record radio/teletype transmissions striking the aircraft. This receiver was constructed by Higgins Laboratories, at Menlo Park, Calif., and it was equipped with two antennas. One of them was type NP 11770, the other NP 11570. The manufacturers taped a record of the frequency and strength of all signals reaching the aircraft so that the information could be examined in detail after the flight.

- Seven camera windows, each an 18 in. right angles in diameter, in a section of the fuselage. Camera model 718 was installed in the fuselage with enough film to photograph all of the Russian territory it passed over during its flight of more than 5,000 mi., according to the Soviets. Farthest size of the photographs made by the camera was 9 1/2 x 14 in.

- Astrotracker, believed to have been made by Kellman Instrument Corp., was installed on the U-2 to provide a reference to aid in orientating the photographs and other reconnaissance data.
- Automatic radio direction finder AN/ARN-6 made by Bendix Aviation.

- UHF command radio AN/ARC-34 produced by Magnetics, which has 23 preset channels and one guard channel for emergency. Using this radio, the pilot could communicate with another aircraft every hundred miles away if they were both at very high altitude. It would be difficult for him to reach a ground station over a thousand miles away with this standard set.

- Low outboard A-16, which is similar to the lightweight L-1 model the Soviets supplied for the North American F-50.

- Low compass system Type MA-1
- Pneumatic starter for the J75-F-11
- Hydraulic-powered, flap control gearbox.

- Alternating current and direct current power sources.

Equipment in the U-2 which the Soviets said was intended for its destruction in the event of an emergency air and a spare plate of Reskins and Whirley, Inc. Its assembly number was MDL 17510A.

Damage to the cockpit section of the U-2 at Gorki Park indicated the failure of the wheel as the cockpit section and one landing gear were pulled. Six green oxygen bottles were intact.

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## U-2's International Repercussions

Washington—Soviet Union turned the U-2 incident into the United Nations last week in the armed espionage case (AW May 26, p. 28) continued to trigger a series of international repercussions.

Soviet Foreign Minister Andrei A. Gromyko rebuffed the U-2 pilot to the UN and demanded a meeting of the Security Council to stop "the act of espionage and the crime of the United States" in sending espionage flights across Russian territory. Request for UN action was the latest in a series of reactions in which:

- Paris summit conference collapsed when Soviet Premier Nikita Khrushchev demanded that the U-2 pilot in U-2 intelligence flights be "to be condemned," analogous for those nations that and punish those responsible for sending them.
- Khrushchev refused to meet the demands.
- Khrushchev ordered President Eisenhower among lines of making "no further the basis of his policy with regard to the Soviet Union" and withdrew the invitation to the President to visit Russia next month in exchange for the Soviet prisoner's free of the U-2 but was Khrushchev also suggested postponing the summit meeting to six right month—Soviet's next offer for the President has left the White House.

- U-2 flight operations were suspended before the summit meeting although the President decided not to reveal it until the summit met. Making it clear that U-2 operations had been halted in May 12, President Eisenhower also said he had planned to propose a UN action committee within weeks to the "open door" program made at the first summit meeting in 1953. Russians rejected the proposal then and continue to oppose it.

- Protesters were killed by U-2's also implicated in the U-2 incident. Soviet Union sent notes of protest to Norway, Poland, and Turkey over these acts in the U-2 flight. Norway sent a protest to the U-2 against the planned use of a Norwegian landing field for the U-2 which came down in Russia and landed on Norwegian territory and the U-2 is a member of the U-2 which came down in Norway.

- In addition, Denmark, which was not implicated in the Soviet U-2 incident, has banned the use of its air field for any unauthorized flights over countries not members of North Atlantic Treaty Organization. Incident also prompted Japanese government officials to give that support of the Japan U-2 Service Force. U-2's caused Japan that U-2's obtained there (AW May 2, p. 28) had been made.

- Khrushchev rebuffed the Soviet Union has known of U-2 intelligence flights over its territory, in some cases when he not be about brought the subject up during his conversations with President Eisenhower at Camp David during his U-2 case last fall.

- Soviet Chief of Air Marshal K. A. Voronov proposed a trip to the U-2's planned for him and one other because of "unfavorable circumstances."

but somewhat MacLeod. Pilot's eyes were not defocused but the engine was only slightly bent with some glass intact.

Pilot Francis G. Powers' helmet had broke, and broke as in the first but that was the only visible damage. The pilot's boots were in perfect shape in Gorka Park. The parachute harness had no stress on it and the chute's canopy and webbing, canopy was unscathed.

Damage to the aircraft structure was limited in the center fuselage section where the Soviets claim is the rocket's rocket hit. Western observers at Gorka Park said that the rocket, if not actually struck, the plane must have been seriously or crippled with a light warhead. The wings were damaged all at the roots and trailing edges on both of these were badly torn. Left wing was almost scratched instead of the trailing edge damage, with the bottom of the wing tank, but had no air leading edge damaged. Right wing had jagged holes 5 to 10 in in diameter on top.

## Kivi Reactor Facility Construction Starts

Indianapolis, Ind.—Advanced Reactor for Power (AEC) reactor model program is scheduled to begin static tests next year. As in the eventual flight program, the reactor will not be liquid hydrogen in the working fluid. The reactor, Inc., under a prime contracting contract from the Atomic Energy Commission, has begun construction of the reactor test facility.

This summer AEC expects to test the reactor in the Kivi's first test. The Kivi's reactor was not under test until (AW June 29, p. 18). The reactor test facility, an advanced reactor, which may be given the designation Kivi-1, will have a design for liquid hydrogen but no production capability. It is expected that the liquid hydrogen will be trucked to the

Nevada test area from plants in California, and possibly Florida. Air Force which has a large liquid hydrogen plant at West Palm Beach Fla. (AW Feb 27, p. 18) recently purchased three 7,000-gal. insulated tank trailers that reportedly can carry liquid hydrogen across the country without venting any gas into the atmosphere.

Contractors team for the advanced Kivi project is expected to follow closely the design selected for the Kivi-A France work (AW Feb 5, p. 64). In addition to the reactor, it will include Edgerton, General Motors, and Ceres Inc., for control and monitoring instrumentation for test cell and reactor. It is also assumed that AEC in the reactor, Inc., will be a member of the team.

## News Digest

Rafael Corp. of America has received a \$115,000 Defense Department contract in connection with Advanced Research Projects Agency program to develop positive means for absorbing nuclear warheads from their electronic warhead cables in their electronic. Contract covers automatic data processing of radar data.

Rumors prepared a helicopter to India—understand by U-2's sources to be the M-16 and the Indian government and it is to be used in the future. Further details: India, however, is not entering a helicopter proposal on building the S-67 in India with the S-67 and the landing commander to fill in India equipment for a 1-gigabyte aircraft for troop transport to its northern border area.

Lockheed Electron operations have been ordered by the Federal Aviation Agency to check the electron controls of the helicopter transport to avoid the possibility of in-flight buffering which would mean dropping, in a Eastern Air Lines F-4 Phantom in current flight from St. Louis. FAA mechanics declared any connection between the incident and Electron nadir investigations near Buffalo, N.Y., and Tullahoma, Ind.

Mr. Gen. Stanley T. Wain, commander of Air Research and Development Command's Wright Air Development Division will move to the Pentagon in Feb. as director of the Personnel Council at the Office of the Secretary. He will be replaced by Mr. Gen. Joseph E. Hinkle, new director of Systems Management at WADD. Hinkle will be replaced by Mr. Gen. William T. Coffey, new vice commander at the Manassas Development Center, Hattiesburg, MS.

## TWA-Northeast Merger Sparks Debate

First in expected series of airline requests draws varied reactions; opposition to plan expected.

By L. L. Doty

Washington—First of a series of mergers which key airline managers are convinced will be reached off by mounting competition in major air travel markets was proposed last week by Northeast Airlines and Trans World Airlines.

Industry reaction to the merger proposal, which has been discussed in industry circles for at least a year but which was actually resolved within the past few weeks, ranged from violent opposition to passive acceptance of the move. Both National Airlines and Eastern Air Lines can be expected to put up a vigorous fight against the strengthening of a competitor on the already hotly competitive New York-Miami route (AW Jan. 18, p. 36).

Other carriers view the proposal as an acceptable result of strong competition, multiple companies on major routes, and an expanding volume of available seat sales. Airlines leaders have been working with increasing interest that, because of the fierce battle between Eastern and TWA beyond 1960 is highly questionable (AW Dec. 2, p. 26).

Here are typical examples of how the industry now stands on mergers.

• **C. K. Smith**, president of American Airlines, is not taking mergers with any company. Smith, however, feels that some mergers are essential to the fiscal health of the industry and has called upon business and government to encourage profitable, constructive mergers.

• **David H. Baker**, president of Capital Airlines, will seek a merger—probably with an eastern regional-type carrier—once the pending legislative committee on the Vietnam-Vietnam trade-memorandum proceedings against it are resolved (AW May 9, p. 38). Baker and other traffic of merger would be no longer traffic loads, airline operating expenses would be reduced, and revenues would be increased.

• **Robert F. Sox**, president of Capital Airlines, also views the need of mergers within the industry but believes that his company has had an increasing firm financial position in such a way that, when the time comes for Continental to consider a merger, it will be in a position to dictate terms rather than be forced to accept acquiescence.

• **Charles E. Beard**, Trans World Airlines president, says himself that "we are not seeking a merger, have not been approached by another airline for merger."

• **C. E. Wickham**, president of Delta Air Lines, sees no need for a merger so far as his carrier is concerned. "We don't see any reason to combine with a

He said, "if we can get both, we're interested and we might be willing to let the other fellow bite the lead (AW May 16, p. 36).

• **George F. Baker**, National Airlines president, has no specific merger plans. Baker is strongly opposed to the proposed Northeast-TWA merger and told American West that the "CAB got involved in a Florida route so that it could get off already, not as it could go on."

• **Donald W. Nyrop**, Northwest Airlines president, is interested in arranging a company when it will "benefit" Northwest. He is not interested in merging with Capital, viewing a merger that has been previously considered within the industry during the past few months.

• **Frederic G. DeWolfe**, Western Air Lines president, feels that traffic growth potential in the far west traffic zone where the carrier's operation is heavily concentrated, will remain intact.

• **W. L. Anderson**, Eastern Air Lines board chairman, has said he is interested in a merger if it would bring increased earning power and leadership.

## Capital Board Shifts

Washington—Capital Airlines last week voted major changes in its board of directors as a first step toward reducing revenues in its long-term management structure which it hopes will use the company's assets more effectively.

Under the changes, Charles H. Smith, whose 90,000 shares of stock represent the largest single holding in the company and who recently made an unsolicited bid for the local chairman slot, was dropped as chairman of the board.

Smith was replaced by Arthur F. Krueger, a board member for several years. Smith will remain as a board member.

In addition, Capital's contact with Northeast's late President, Charles Wickham, Kent and Anderson, president of the company has been transferred to Thomas D. Nichols, Jr., for the Capital board member and New York investment banker, who acted chairman of the board.

The second round broke a deadlock that has blocked the carrier from making recent changes in management which Wickham has felt was necessary to get the company back on its feet.

The proposed Northeast-TWA merger will require approval of shareholders of both companies, major creditors, Securities and Exchange Commission and Federal Reserve Administration. It is quite possible that the Justice Department will review the proposal.

Each company is owned by a single majority shareholder: Atlas Corp. controls 50% of Northeast, and the outstanding common stock and Hughes Tool Co., which is solely owned by Howard Hughes, controls 75% of TWA's common stock.

Under a Civil Aeronautics Board order issued in August, 1958, Hughes' Atlas stock is held in trust under which Hughes has relinquished his voting rights in the carrier. The order also requires that Hughes have no "direct or indirect" interest in Atlas Corp. as long as Mr. Hughes has not sold his Trans World Airlines and Atlas stock.

Thomas B. O'Brien, founder of the Atlas Corp., an investment company with 50% interest in Atlas, chief executive officer and chief executive of the organization. He will be succeeded by David A. Stretch who is also involved in the operation of the organization of the Northeast-TWA proposal.

Since the Northeast-TWA proposal

merger calls for an exchange of these shares of Northeast common stock for one share of TWA stock, Atlas will lose its position as a majority stockholder in any airline if the merger is approved. Although O'Brien's retirement apparently had no connection with the merger, he did state that "I now feel free to retire" since arrangements for re-acquiring Northeast with the airline have been "completed."

James W. Anderson, president of Northeast, told American West that the carrier's board of directors approved the merger proposal last week "in principle" and added that the "thinking" of the Northeast board on the proposal has been submitted to the TWA board for consideration. The TWA directors are expected to act on the merger plan at the next regular board meeting later in June.

If approved, the plan first goes to the stockholders for their consideration. A majority of the 200,000 common stockholders, about 25% of the TWA stock ownership, must vote in favor of the merger if it is to be approved.

Anderson expects opposition to the merger plan from many quarters and forecast a "real Dismalbrook" before the vote is finalized. He said that no decision in this stage of planning has been reached as to what date he and his officers will fly on the merged organization.

National Airlines has already petitioned the CAB to cancel or suspend Northeast's licenses New York-Florida certificate authority. It is quite possible that the Justice Department will review the proposal.

Other airlines serving the Florida market—most in all—probably will also be petitioning the North coast TWA plan.

Major losses in the case will be the CAB, which must have the responsibility of making a decision that will be undoubtedly be accepted by industry as proposed. Recent statements by Board members have suggested that proposed merger will get a cordial reception, and a large number of industry observers feel that the Board will act favorably in the TWA-Northeast case as an act of helping to ease the financial crisis of the industry.

The far remains, however, that competition in the East Coast-Florida route is so fierce that the three competing companies—Eastern, National and Northeast—have been under operating in the red or at marginal profit levels



## Delta Convair 440 Service

Delta Air Lines will begin the first airline to place Convair 440 turboprop transport into scheduled service with the acquisition of regular flights between New York-New Orleans, Atlanta and Houston. Service will be extended between Dallas and Atlanta on May 28 and between Chicago and Houston on June 1. In all, the airline will have 18 in the 1960s of the airline in scheduled operation. The aircraft is powered by four General Electric JT200-8-Convair JT200-8 turboprop engines, the first jet propeller to operate in commercial scheduled service.

during the past year. In addition, the Florida market market has recently shown signs of losing some of its former strength, and a number of observers feel that it has held up this year only because political action in Cuba has discouraged Caribbean tourist travel (see p. 47) which would have diverted a number of vacationists from Florida winter areas.

Since 1953, CAB has received 20 merger proposals and approved 10. Northeast has been involved in seven of these proposals, with Capital in 1945 and one with Western in 1945. Both of which were denied by the Board. TWA has not been involved in any merger negotiations that reached the CAB approval stage. The merger TWA acquired Mergers Airlines in 1940.

## Northeast 1959 Loss

Northeast last week showed a net loss totaling approximately \$7 million, although passenger revenues increased 10% over 1958 and revenue passenger miles declined 27% over the period.

TWA's total 1959 revenues were 22% above those of 1958, and the net profit for the year was \$8.4 million, record highest in the company's history. The company will report a net loss of \$6.8 million in the first quarter of the year (AW May 2, p. 26).

Northeast has consolidated arrangements for the loss of its Convair 440 jet transports from General Dynamics Corp. and General Electric Co., which manufactures the carrier's JT200-8 propellers. The carrier is a part of the JT 440 transports ordered by Hughes Tool Co. for use in TWA.

In addition, Hughes Tool Co. will

load Northeast up to \$5 million for the acquisition of the turboprop into its fleet. The airline will be in service on the Florida route before the winter season begins. The airline will continue to operate the new Boeing 707-314-400s from TWA.

Each Convair 440 will go into service as TWA starts this summer. At present, TWA is operating 11 Boeing 707-314s and one 707-314s on domestic and international routes as well as the 156 revenue engine transports in the carrier's fleet.

Howard Hughes recently ordered a \$540 million financing program for TWA to cover purchases of jet transport aircraft. The program will be provided by insurance companies and bond groups with the balance coming from \$100 million in subordinated debentures to be offered (see October and 500 million from Hughes, if required).

As of Dec. 31, TWA had 6.7 million shares of common stock outstanding. Under the new financing program, the company, a increasing the number of outstanding shares from 10 million to 15 million. Northeast had 1.9 million shares of an authorized 1 million shares outstanding as of Dec. 31. In addition to the 994,216 shares of Delta, Atlas also owns 512.2 shares of Northeast's common stock.

The merger would result in a very slight dilution of shares in the new airline as that little or no percent non-petition would be eliminated, a fact that the CAB would find, upon review by Charles Wickham, TWA president, and that other parent plans, all routes would be absorbed, including Northeast's local service routes in the northern New England.

# Support Urged for Supersonic Transport

By Paul Eastman

Washington—Top government and military officials last week urged Federal Aviation Administration support of a supersonic commercial transport and said continued development of the Air Force-North American B-70 Mach 3 bomber is "vital" to the program.

The officials, speaking before the House Committee on Science and Astronautics investigating the problems connected with the development of a supersonic transport, included Elwood Quesada, administrator of the Federal Aviation Agency; Maj. Gen. V. R. Hargens, Air Force director of development and planning; Lt. H. Abbott, director of advanced research programs for the National Aeronautics and Space Administration; and John Adams, associate director of the Civil Aeronautics Board's Bureau of Air Operations.

Quesada told the committee it would require approximately \$500 million to build a prototype of a Mach 3 transport suitable for commercial operations after drawing heavily from the knowledge gained from the development of the B-70. Other witnesses indicated that the new model might require \$500 million to \$1 billion, a burden too heavy for one manufacturer, or a group of manufacturers, to bear alone.

## B-70 Need

Key factor in development of a supersonic transport is continued progress in the development of the B-70, Quesada said. "Without it," he added, "development of a supersonic commercial transport is hopeless."

While the B-70 could not be converted into a suitable commercial transport, Quesada said development and testing of the bomber will supply the know-how to "solve" questions needed to build a commercial transport can be built.

FAA and NASA are conducting a program to identify and solve the basic problems of developing a maneuverable supersonic transport (AW May 2, p. 68).

In the past, Quesada pointed out, commercial transport aircraft have largely had their basic civil airliner counterpart already in being, or at least from prior military development of prototypes or major components.

In the supersonic field, "he said, "there is no advanced military airplane configuration easily adaptable to conversion for civil transport use. Hence, there is a very real possibility that, unless some new approach is taken toward development of a supersonic transport,

further progress toward such a craft may not take place."

Quesada suggested that the best approach to the problem is that the capability for the development should be sustained by industry, with the government furnishing coordination, financial support and specifications for the aircraft, which also would have military value.

He said the development should be undertaken by an industry team rather than by a single company, although manufacturing of the aircraft probably would be carried out by one firm since less than 200 aircraft would likely be required throughout the world.

Cooperation, he said, should be confined to design competition between manufacturers and, since the design has been selected, the start of construction of the prototype should be predicated on that firm.

## Keenest Competition

Quesada also said he felt the government should be able to secure a portion of its financial support by placing a service on each aircraft sold commercially (see last page), much in the same manner as the British government recovered the cost of development of the Vickers Viscount turboprop transport. This also was suggested by Robert F. Cox, Commercial Air Lines president, as a factor to encourage Chairman Owen Bieber (D-Mich.) to support the program.

Gen. Hargens said the Air Force considers development of a supersonic transport to be technically feasible and a "desirable national objective" and that it should be maintained at a national effort, combining the resources and talents of many government agencies and industry.

The best approach to building a commercial transport, he said, is by the

way of an offshoot of the B-70 prototype development. To design and build a supersonic transport from the ground up, he said, would result in an expensive effort by 1964 program but it would be difficult to support the expensive model.

"We have already expended almost three years of development effort and some \$150 million on the B-70 program," Gen. Hargens said. "By continuing this effort, we are already far along the path that must be followed to develop a transport capability."

## Additional Prototype

Gen. Hargens suggested that, while the B-70 is "inherently not optimized for a transport," an additional prototype vehicle could be configured to carry approximately 100 passengers and used to obtain the data necessary for the final design and operation of an efficient transport. When the B-70 development confirms the ability of a transport configuration, he added, a prototype vehicle could be bought as a service within a short time and with advance model funding when compared with the system approach.

John Adams, speaking for the CAR, said it is certain that a commercial transport will be developed and will appear on commercial routes, perhaps within the next decade. He added that there is an "overriding necessity" that such an aircraft be built by U.S. companies and manufacturers. "He told the committee.

"If our country were to stand by and permit another country to step into the American position of preeminence in the field of aircraft development, it would be a tremendous blow both to the prestige and the economic stability of the American aircraft manufacturing industry."

With estimates of the cost of development of such a plane ranging from \$250 million to \$1 billion, he said it is obvious that full financing is beyond the capability of one or a group of government agencies, and that some form of government assistance is all but necessary. Adams also told the committee.

"The tremendous speed of the aircraft if accompanied by proper aerodynamic and ground handling equipment would be such that aircraft with long distance routes could operate three months with about one-third of the equipment needed to operate current jet equipment."

With a high cost of the aircraft (estimated at \$125 to \$25 million), together with its tremendous capabilities, could very well mean that many nations would have to utilize technology agreements in order to get sufficient produc-

## Military F-27 Proposed

Washington—Futrell Engine and Airplane Corp. has proposed a military version of its F-27 turboprop transport to the Defense Department for immediate production. From a price quote of between \$10,000 and \$11 million, the plane would be based primarily on a M-250C model now in use by North Carolina Consolidated Airlines. It can be offered with one landing and STOL performance.

Maximum gross weight could be for military design was 15,000 lb., permitting payloads of up to six tons. STOL version could take off with a gross weight of 140,000 lb. at a gross take-off weight of 140,000 lb. and carry a payload of 6,000 lb. over a 100-foot runway, according to Futrell.

Aircraft would be powered by two Rolls-Royce 2,500 cycle Dart 8 turbo props.

to convert the investment staff.

"Manufacturers to whom board reports indicate to have been operator that no manufacturer could build the aircraft without initial orders for between 40 and 50 aircraft, and most of them assume that, in order to be profitable, whatever manufacturer gets the initial order probably will have to manufacture all the aircraft which are built, although some concede that perhaps two manufacturers, each capturing about half the business, might build the aircraft profitably."

"The economic return on the aircraft would require the aircraft to fly so high (55,000 to 75,000 ft.) that economic utilization would be possible at distances of less than 1,200 to 1,800 mi. Consequently, current supersonic aircraft had routes probably would not be able economically to use the aircraft."

Mr. Abbott, in urging government financial support in the development program, said that the NASA is providing with aircraft, "the fact has now arrived which research is itself is not enough if progress is to be made at the rate that is technically possible."

A concerted effort by the government and industry design teams is needed to bring the public into the field and perspective, and to enter the field and resources essential to such a difficult task."

## Design Criteria

In designing the supersonic transport, Abbott said the following requirements must be met:

- "Payload volume must be larger than that of the supersonic bomber to accommodate the passengers.
- "Each aircraft should have a long

operating life of more than 40,000 hours of flight to be economical.

- "The airplane must be convertible with the airports from which it is expected to operate and with the traffic control system that can be brought into existence at the time the airplane goes into service.

- "The airplane must be suitable as acceptable in the sense that it must not cause undue noise at or in the vicinity of the airport or over the route it will be flown.

- "Safety requirements are even more stringent than for the bomber and must be difficult to realize."

"The airplane should have substantial growth potential to avoid large later development costs to avoid the difficulties of bringing another completely new aircraft into operation."

Stan G. Tipton, president of the Air Transport Association, also urged government financial support of the supersonic transport development program. "It is clear that neither the aviation

industry nor the airlines are able to finance such an undertaking," he said.

In saying that the U.S. fleet prompt action. Tipton told the committee that "wherever there build a good supersonic transport will be in a position to dominate the air market of the world and of nations will have an unchallenged position for export."

## New Engine

J. B. Montgomery, general manager of General Electric Co.'s Flight Propulsion Division, told the committee first a "new type jet engine capable of powering military and commercial aircraft" is needed. "The engine, which at speeds of up to 2,000 mph, can be produced wherever it is needed."

The new type powerplant, he said, would be equipped to burn fuel as the exhaust of a jet engine directly to avoid the heat jet engine. It is possible to add this idea component to an engine such as GE's J79 engine which has been selected to power the B-70 Montgomery said.

# FAA to Review Engineer Rules

Washington—Federal action that could lead to a settlement of the current new requirement issue between the Air Line Pilots Association and the Flight Engineers International Union was taken by the Federal Aviation Agency last week.

Noting that it has been approximately 12 years since public hearings that involved the requirement for the addition of flight engineers to some classes of airline aircraft, FAA sent a notice of conference calling for a review of flight engineer requirements. The conference will be held in the next few days. The notice was dated May 18, and the conference is planned for June 6, 7 and 8.

Primary reason for the conference is to determine whether the current flight engineer regulations are adequate for flight safety for turbine aircraft operations, FAA said.

Scope of the proposed rules will cover a variety of questions, including such as whether the FAA is providing for flight safety for turbine aircraft operations, FAA said.

Proposed revision of the present regulations requiring flight engineers based upon aircraft weight is aimed at clarifying much of the conflict between regulations governing domestic and international operations and airworthiness regulations governing type certification.

Essentially, present FAA regulations

require a flight engineer on all four engine aircraft certified for more than 50,000 lb. and others certified for 50,000 lb. or over, when flight is necessary by the instrument. Other sections of the Civil Air Regulations contain the more requirements but stipulate that the 50,000 lb. rule applies to all four-engine aircraft, while no such stipulation exists for two-engine aircraft. The FAA said it is possible to add this idea component to an engine such as GE's J79 engine which has been selected to power the B-70 Montgomery said.

## Present Regulations

Industry observers point out that these regulations fail to cover the new compliance question on such aircraft as the two jet Jet Cavalcade, which has been certified for a maximum takeoff weight of 100,000 lb. FAA says its position will be to determine whether it should make its requirements identical for all engine aircraft, and also clarify the rule to include "partial cockpit" provisions from two-engine aircraft. At the same time, the agency said it will consider incorporating the weight requirements into the airworthiness regulations.

FAA wants to undertake a detailed study of flight engineer duties related to the question of what cockpit instruments should be available to the crew member in order to comply with airworthiness regulations which require cockpit to be maintained for continuous operation and avoidance of loss of control.

# Airlines Ask Airports to Balance Costs

By Gloria Gorman

New York-Airport executives were asked last week not to "fill the gaps" that lay the golden egg by requesting airlines to pay more than they should at the cost of airport construction and operations.

Robert E. Peck, president of Midland Airlines, asked airlines attending the annual conference here of the American Assoc. of Airport Executives to exercise a degree of caution in not letting the "gaps" "fill the pot suggesting that there is an increasing tendency to expect more and more of the gaps. Peck said during a lunch session and-over-seen report to addresses in a panel of four airline presidents.

Midland A. MacIntyre, president of Eastern Air Lines, was the panel's moderator representative. In addition to Peck's local session presidents who participated were Gov. P. Healy of Lake Central Airlines and R. Earl McKnight of Trans-Texas Airline.

MacIntyre described the airport and airport operation as "joint ventures" but said airlines could hardly be expected to put in a "multiple" loss for airport operation. Carriers he said have no way of raising efficient low cost operation by the airport officials.

The Eastern official called for volume discounts on charges to airlines with high frequency service.

## Expansion Risks

Both airports and airlines should share the risks of expansion, according to MacIntyre. Airports don't provide guaranteed payoffs to the carriers, and perhaps both should be prepared to face, directly or in the long run, at least a risk of loss and airport expansion.

MacIntyre was cited how traditions regarding the future of new high airports since the turn of the century have been changing. "Traditions," MacIntyre said, is somewhat different than most trends in that it is to some degree also a local service carrier, with a policy aimed to concentrate within its system. It is not common to allow service to non local areas except possibly a few "political" planes.

Eastern's expansion program — "which we're bringing to a head" — will consider such service, MacIntyre said, but he's not in an expansion mood as far as service to local points is concerned.

Regarding future use of smaller jets not only at small airports but with increased frequency at larger airports, the Eastern official said the frequency question has to move ahead before one looked. There will be a shift, he pre-

dicted, and more service of the Carri- trols will be built in the future.

Among the airlines complaints was alleged failure on the part of airport officials to consider the airlines' views for costly expansion projects. When a city undertakes a planning McKnight said, the airlines are the last to be consulted. "Usually, after plans have been drawn up," MacIntyre said, "the airlines find out the value of an airport consultant and not the carrier in determining expansion projects."

However, the airlines have not shown that they are capable, in this case, of bringing enough personnel to assist in airport planning as by offering within this plan, McKnight said.

Outgoing AAAE president Edward E. Lippert, Tex., told Airlines Week that the airport operation would welcome more carrier participation in planning, giving the airlines a voice, in what they will occupy and "before it's a fact enough."

But it has been a problem, in the past, Calles said, to get the airlines to participate or to enter the discussions early enough. One recent problem the airlines have encountered in this regard, he said, is that of small airport programs, expanding carrier technical personnel somewhat than and making it more difficult for them to participate in individual programs.

Agreeing with the desirability of greater airline participation in airport planning, incoming AAAE President C. Edgar Peters of Indianapolis added a reservation. Many carriers, he said, hesitate to agree as much as they might if it will mean the loss of the money involved. There is nothing about these local areas, he said, on the side of too little or too much and the fact.

Also where several airlines are involved, it can be difficult to achieve unanimity, in what they believe will be required, according to Peters.

Calles noted the complex of negotiation involved in airport planning, including local, state, and federal agencies. However, he said, it is the basic responsibility of the airport sponsor to make the final decision within the local laws.

Some airlines Collier said, contend that their airport user costs have increased more heavily than other expenses and complain that they pay more than their share of the airport costs. This may be explained Calles suggested by the fact that many others in their own stages of airport operation offered very low rates to attract airlines. There rates earned through long term leases and in many cases only

recently have been adjusted to more realistic levels, in Collier's view.

Regarding this point, MacIntyre told Airlines Week that in many cases there might not have been about as low the airlines especially had put up the money for such items as hangars, which were built with unpaid rentals. As to participation in planning, MacIntyre said, airlines had not always been cooperative enough. Planning a two-lane street, too be parallel and the nation could provide the airport planners with more information about future schedules and the like to work out related requirements.

## Fare Increases Debated

In the panel discussion the local stress, arises right in whether a low increase would put airlines out of the market. McKnight felt that if fares went much higher, Trans-Texas would lose business to a major competitor, the automobile. But Peck held that even Midland's, under the dollar fare, from those of the Trans carrier in that they serve high density markets where highway connections are congested — it would benefit strongly by an increase which might cut industry needs in half. Peck said he has never heard a passenger complain about the fare. Healy, concerned with Peck, said a 17% increase on an \$11 average Lake Central fare would not discourage business.

The AAAE members at another session heard Dr. H. Abbott, director of the Office of Advanced Research Programs, National Aeronautics and Space Administration, as to the U.S. could hold, improve its transportation within North America. He said it would be deeply involved in several in a March 2 commercial transport.

Roman requirements for the super-sonic transport are difficult to pay down, Abbott said, but his study of a four-engine, 100-passenger design indicated that it could rise off in less than 10,000 ft. But Roman and two other, said, will require considerable modification and manufacturing.

Construction of a super-sonic transport will be hard, difficult than building the B-70. The NASA official predicted the money is the additional space and because of its design, needed for passengers and baggage. Choosing the right one will be critical.

How much of NASA's work is directed toward aerodynamics and how much toward space flight, Abbott said, is impossible to determine, because there is no clear dividing line. For example, research in heat resistant metals might result in applications in both areas.



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# Boyd Foresees Stiffer Route Policies

New York-Civil Aeronautics Board is likely to adopt more stringent standards for approval of new route requests to airlines, CAB Member Alan S. Boyd told the National Federation of Travel and Audit Societies here last week.

Boyd explained that he meant stringent in the sense of legal proof. In some civil cases, he said, a preponderance of proof is sufficient to win, in others it must be clear and convincing, and in criminal cases evidence must be beyond a reasonable doubt. Thus the Board, he said, is likely to start on a greater degree of proof-clear and convincing evidence rather than a preponderance with which past policy might be compared (AW May 2, p. 18).

"By more stringent," Boyd added, "I don't mean more taxation coming in to justify as every Chairman of Commerce coming in with endless statistics and looking up the record book and crying."

"The prime test of government policy should be to ignore the least objectionable. Many can be of some assistance. It is legally and practically feasible, a requirement of routes through airports and/or refinements can be helped. Technical progress would have made this necessary in any event."

Competitiveness, Boyd said, is not the root of airline failures, Board said. The statute requires competition, and if there is not competition, competition, the Department of Justice may enter the picture. But, he added, there can be vigorous competition without having any control over pricing between two cities.

Boyd took part in a discussion of airlines with Albert H. Gordon, senior partner, Kolder, Peabody & Co., representing the financial community; Joseph, and Stuart G. Kroger, president of the Air Transport Union, as an airline spokesman.

Both Gordon and Boyd agreed though not in degree, that airline companies have some share of the responsibility for what airline management complaints of an excessive route authorization. Both made the point that all the routes in service today had been aggressively sought by the operators themselves. But Gordon added this criticism of airline management:

"When I testified before the CAB in the General Passenger Fare Investigation, I was shocked by the almost indifference which appeared to exist on the part of top management in this important proceeding. Only one airline had a senior officer comfortable in attendance supervising the program and procedures of his company's case."

"Now surely we could find that an asset as vital as the case structure of the industry could command concentrated attention of top management. Certainly that has been an observation in the public utility field."

The direct one of these cases to increasing capacity, reduced cost, and a consequent need for Board action were on short-haul routes.

Of what benefit is 'free' changeover when the flight is late and the passenger must wait 30 min for his baggage?"

Boyd added: "Most airline passengers realize that changeover, both forward and back, often by air, is not only recommended by the airlines but is not only of the airline."

"It strikes me that industry has pressed on a narrow-gauged line in trying to provide extra which add to the cost of passage, as looking to the speed and add to the passengers' comfort. A more efficient system of passenger handling with such savings as might result could be one way to fill some of the probable capacity and revenue available."

Gordon—who had noted that in the face of a 241% increase in operating revenues over the last decade airline cost savings had only 44% at the time he noted in 1961. "In spite of what Mr. Boyd said, I doubt if that industry has gone into changeover and flown."

Boyd explained the Board's own concern with the financial health of the airlines if there is any collapse, he said, Washington would find the blue of collapsed lines. He played the burden on airline management to find imaginative solutions to financial problems, and to find an appropriate mix of flight scheduling and to reservation rights in selected points at good examples of this.

On the other hand, Gordon stressed the flight of capital from the airlines and asserted that a good deal of the responsibility for this rests with the CAB.

Airlines might be able to appeal to the institutional and individual investors.



Western Air Lines' 707-120 shows addition of ventral fin and extension of vertical tail by 1 ft. The Western aircraft is the first domestic 707 to be delivered with the new tail configuration. First WAI 707 is scheduled to begin operations in June.

Western Air Lines' Boeing 707-120 shows addition of ventral fin and extension of vertical tail by 1 ft. The Western aircraft is the first domestic 707 to be delivered with the new tail configuration. First WAI 707 is scheduled to begin operations in June.

once they optimize technological progress and expenses. But a complete list of 67 investment management groups he cited shows varied substantial liquidations of airline holdings in terms which held such shares. Eight funds sold a total of 111,108 shares of American Airlines for example, five selling out their positions completely.

There were heavy sales in British, Pan American and Eastern, and in the latter only was there a large purchase to approximately match the sales.

"It is an astounding thing," he said, "that with the exception of Northeast—selling at \$1 a share—the common stocks of even such airline as a very recent competitor like, selling at discounts to their book values. Different disparities here, at one time or another, appeared among individual airline stocks but there was always a handful of air transport equities which commanded premiums over book values."

By contrast, not one of 115 electric utility companies stocks available in the market sells below book value. As a partial financing source it is certainly essential that the market price of the equity of any company sell at a premium over the book value for a sustained period of time.

In 1956 and 1957 when airlines as a whole were in a solid boom on which to recommend airline equities (AW Oct. 6, 1957, p. 49), Gordon said, some astute speculators sensed that conditions in the industry were such that they couldn't get more and made considerable profits in the group that produced profits when airline stocks rose in 1956 and 1959. Since then, airlines have lost even those limited profits and returned to their former low levels.

"This performance may be enough,"

he said, "to discourage even the least of airline, hard speculators who bought at the peak of a few years ago. Our search of the airlines who are attracting equity capital primarily on the basis that conditions in the industry are so bad that they can't become any worse, there are looking on a weak reed."

Where no interviews have appeared, the Board has had a respectable record, he said but it will be difficult to find some cases where it lost one corner will not but its interests are affected.

"One person argues that the reason he fails and such interest have been left before the Board," Boyd said. "Certain cases might like to close the Board, but they cannot discontinue the process."

As to the encouragement of merger, Boyd said the Board's authority in this area is negative, that is, it cannot issue an order without doing serious harm, dealing with public interest in absence of trade etc.

"This does not provide the Board with a very big stick," he said, "It should certainly convince anyone that the Board cannot force a merger or consolidation. It is entirely possible that a series of mergers or consolidations might be beneficial to the traveling industry and in the public interest. There is nothing in the Federal Aviation Act provided for the creation of existing corporate combinations."

Multiplication of competition in some markets over the same routes has been a failure, Gordon asserted, and a complete overhaul of the U. S. airline system is necessary. Better reorganization, merger, suspension and consolidation will be essential, he felt, if airlines are to reach their fullest potential.

In connection with suspension, Boyd replied to a question that the Board's legal department felt that the Board could suspend any carrier on its route, but that suspension legally would be extremely difficult if not impossible. Then, he said, he did not believe the Board had ever exercised its powers of suspension except on request of the carrier.

## British May Restrict Caravelle Night Flights

London-Summer and Scandinavian Airline Service have been warned by the British government that permission for their proposed night flights from London Airport with Caravelles depends on the result of some tests.

Minister of Aviation Douglas Sanders said the tests involved had "taken a character" in announcing specific dates for commencement of these services (Spectrum May 24, SAS June 2). They have been warned, continued Sanders, it is quite likely that the tests will have been needed by the time these services are due to begin.

Sanders acknowledged as "a very relevant consideration" the possibility that if Caravelles were banned at night from London, French might possibly restrict the Concorde, but a Spanish spokesman said that suspended action was "most unlikely."

## Changes in Fund Airline Holdings

The following table, compiled by E. F. Hurler & Co. and based on the portfolios of 42 leading investment firms, shows the quarter changes in airline holdings.

Fund	Purchases	Bought	New Held	Airline	Fund	Sales	Sold	New Held
Financial Industrial Fund	15,000	50,000		American Airlines	Bankers Fund	6,190*	—	—
					Diversed Shares	15,290*	—	—
					Drexler Fund	5,900*	—	—
					Eastern & Midwest Stock	15,000*	—	—
					Raymond Trust of Boston	7,600*	—	—
					Malvern Fund	10,800	40,800	—
					Dreyfus Fund	1,500	6,500	—
Delaware Fund	80,000	40,000		Delta Air Lines	Dreyfus Fund	6,900	11,100	—
International Growth Fund	2,000	22,800		Eastern Air Lines	Easton & Howard Stock	31,400	4,900	—
					Malvern Fund	6,400*	—	—
					Bankers Fund	—	400*	—
					Investment Trust of Boston	30,800*	—	—
					Lafayette Corporation	20,800*	—	—
					Malvern Fund	—	29,200	—

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## Schedules Cut as Traffic to Cuba Drops

By David H. Hoffman

Faced with rapid toll-offs in tourist traffic, U.S. airlines operating into Havana, Cuba, have slashed their schedules, thus dooming an increased proportion of a dwindling passenger flow to Cuban flag carriers.

Despite this diversion and a streak of precaution last winter in which the Cuban government indirectly scheduled airline travel to Havana, the largest of the Cuban eastern-Guinea-Columbian Airlines, S. A.—was hard hit by falling load factors.

Last May, Colombia, along with six other airlines and airport companies, was seized by the Cuban government. Operational control of the carrier was given to the ministry established to receive property obtained by officials of former President Betancourt's administration through the use of Cuban treasure hunters. Since then, aerial management of the airline has been entrusted to a government-appointed intercarrier.

Still nominally a private company, Colombia has postponed its commitment to purchase two Boeing 707-120s. Their receipt, as Colombia negotiators were based to Western Air Lines by the manufacturer and will enter service next month.

Earlier, one of four Vickers Viscount 815 turboprop transports by Colombia was sold off the line to Transamerica Co. Transamerica Corp. Last March, during the peak Cuban tourist season, the carrier leased one of its four Bristol Britannia 310s to Eagle Airways, Ltd. Adding to Colombia's scheduling and equipment problems have been a string of recent incidents in which Viscounts flying Cuban routes were downed or dented by men seeking political refuge from the Havana government. Twice in 1959 Colombia crews were forced to jump-joint to fly enroute to Miami, Fla.



BRISTOLMAN 310 turboprop transport on ramp at London Airport was crashlanded and repaired by Bristol Aircraft after Eagle Airways, Ltd., based at Rome, Colombia.

Last month, the pilot and captain of another Viscount reduced the central tower of Havana's Jose Marti International Airport claim they would not, airlines in Miami.

A third incident and one passenger fled similar requests.

After landing, the pilot received the freezing of the plane's door turboprop giving Miami Airport authorities the reason that he wanted to deny Cuban Communists use of the aircraft. Damage was estimated at \$700,000.

New engines flown in by Colombia were installed by American Airlines, Inc., and the plane was returned by the carrier two weeks ago.

The announcement of U.S. tourists to Havana—which increased relatively constant during the revolution that brought Fidel Castro to power in January, 1959—begins to plummet last winter. Based upon data filed with the Civil Aeronautics Board.

• National Airlines flew 11,661 passengers to Havana from New York, New York, and Tampa during December

1958, and January and February, 1959. The carrier's comparable figure for the same three months of 1959-60 was 5,656—representing a decline of about 49%.

• Pan American World Airways flew 58,248 passengers between Havana and Miami during December, 1958, and January, February, and March of 1959. In the same four months of 1959-60, the airline carried 26,844 point-to-point passengers—representing a decline of about 54%.

• Delta Air Lines flew 2,784 passengers between New Orleans and Havana during December, 1958, and January and February 1959. The carrier's comparable figure for the 1959-60 season was 1,535—representing a decline of about 45%.

Delta's share of U.S. to Cuban traffic, though small, assumes significance because the carrier operates a route outposts between Havana and New Orleans, whereas Pan American and National operate directly with Cuba. On Jan. 1, 1960, Delta dropped one weekly round trip from its schedule, continuing a trail of eight flights per week into Havana. C. E. Woolson, executive, told Aviation Week that Delta also had subscribed to "increase insurance" to protect its aircraft visiting Havana from accidents from possible one. Executive by the Cuban government.

National, during 1958 and 1959, flew three daily round trips to Havana from Miami plus one daily flight from New York and from Tampa. On Jan. 11, however, the carrier cut its service from 48 three points to three round trips per week.

The American, during the 1958-59 tourist season, operated an average of 46 weekly flights between Havana and Miami. During the 1959-60 season Pan American operated the 16

### Cuba-U.S. Passenger Flow

Period	Total Passengers Between U.S.-Cuba	Per Cent	U.S. Flag Passengers	Per Cent	Cuban Flag Passengers	Per Cent
Year Ending June 30, 1957	410,081		364,770	89%	24,310	41%
Year Ending June 30, 1958	263,724	64%	226,326	85.9%	22,398	36.9%
Year Ending June 30, 1959	240,326	74%	224,629	93.5%	26,696	37.6%
So far in 1959						
July 10						
Dec. 31, 1959	222,216		194,671	87.6%	17,545	40%
*Estimated						



into flight at a range of 32 times each week.

As traffic volume to Havana declined, the number of flights to Hong Kong to the Cuban capital from all points in the United States increased the number of American flights. A majority of these flights were Cuban national and presumably favored Cuban flag airlines in choosing a carrier.

#### Airline Traffic

In the year ending June 30, 1957—the first of the so-called normal years before the outbreak of fighting in Cuba's Oriente Province—airline carriers accounted for 31.4% of the 621,585 passengers that traveled to and from Cuba in air.

But during the six months ending Dec. 31, 1959, when recorded for 31.7% of total passenger traffic.

With further conflict with the United States on the part of U.S. airlines (generally a larger share of overall U.S. to Havana passenger traffic for Cuban carriers), the trend established in the three years preceding June 30, 1959, is likely that Cuban carriers' share of total traffic to U.S. competitors was increased during the last half of 1959. For at some point within that six-month period, U.S. airlines were reported of about 10% of their previous year's share of air traffic between the U.S. and Cuba. In January, the last month for which data was available, Cuban carriers were flying about 40% of scheduled and confirmed passengers.

More than offsetting the percentage gain of Cuban flag operations, however, has been the overall decline in air travel to Havana, the full impact of which probably will be felt next winter. Even so, since, however, had been on Cuba's daily *Bohemia* flight from New York to Havana is being off. According to airline sources, they averaged 70% in January, 65% in February and 58% in March on the 95-seat helicopter aircraft.

Figures on air work for the Port Authority of New York and made available to Aviation Week by Cuban industry in the 1958 calendar year, the country's total traffic between Havana and New York equaled 15,497 passengers in 1959, that number rose to 41,351.

#### Comparisons

Comparing passenger loads, Cuban flow 10,544 passengers between New York and Havana during the December through March period of 1959-60. During the same four months of 1957-58, the airline carried 14,763—an increase of about 25%.

Partially explaining Cuba's high January load factor on the route is that "Piedra Blanca" provision (right

by the Cuban Tourist Commission (CTC), an agency of the Cuban government. This lasted from Jan. 5 through Jan. 31 in New York and from Dec. 23 through Jan. 31 in Miami.

The provision allowed tourists from the U.S. to enter a 90% discount at a hotel of their choice in Cuba. CTC reports that 17,000 tourists accepted the voucher distributed by the airlines and applied for the scheme.

From Feb. 8 through Mar. 7, the CTC authorized a second provision in which tourists were offered a free night at a hotel with dinner plus ticket to a sight-seeing tour, beach, golf course, etc. Some of the flights in success in future were not available.

But problems for Delta Air Lines told Aviation Week that about 40% fewer passengers took advantage of CTC provisions linked to Cuban hotels in 1959 than in 1958.

A top official within the tourist commission staff confirmed that CTC did not contemplate additional provisions to boost tourist traffic to Cuba. Rather, he said, CTC will concentrate its efforts on American travel agents in an ongoing free commission on airline tickets and on by making more of its expenses absorbed in preparing brochures publicizing package tours to Cuba.

#### Tourism's Importance

According to CTC, tourism—Cuba's third ranking industry—should earn the country about \$120 million annually. In 1957, a "normal" year, the CTC reports that tourists contributed about \$78 million to the Cuban economy, of which about 90% was furnished by the roughly 315,000 Americans who visited the island.

"Last year 10% of this number visited Cuba in 1959," a CTC spokesman admitted. Of those, about 75% is being off on visiting Havana, which averaged 170,481 passengers in 1959 (AW Mar. 30, p. 51), the lowest recorded in Latin America.

#### Cuba's Fleet

To maintain American neutrality to visit Cuba in view of recent tensions between Washington and Havana, and also to conserve Cuba's dwindling supply of U.S. dollars, the Cuban government and the CTC have:

- Launched a "See Cuba First" campaign aimed at encouraging aerial visitors.
- Opened new CTC offices in South American capital cities to promote Cuban carriers on the part of other Spanish-speaking nations.
- Closed country restrictions on Cubans who would take U.S. dollars out of the country on business or pleasure trips. Today, all Cubans carrying

U.S. dollars must exchange them for pesos, and the use of U.S. currency in Cuba, formerly a common place in now a penal offense.

Preventing the future of police operations into Cuba is complicated by abrupt changes in traffic flow and aircraft movement that seem to follow the public speeches of Premier Castro and the propaganda activities of his opposition.

Last October, to illustrate, the Cuban government spent \$1.5 million in contracts for 2,800 delegates representing the American Society of Travel Agents (ASTA). It was generally assumed that Premier Castro, with his well-known address to delegates, would have been there in person.

Before the convention had opened, however, a Miami-based Douglas DC-7 piloted by Don Kane, former head of the Cuban air force, landed Havana with anti-Castro leaflets. This prompted Premier Castro to denounce the United States over references for "harboring" the said pilot.

#### Traffic Slumps

In the month following Castro's speech, November, the number of passengers departing the U.S. for Cuba plunged 92% to 11,794. The major factor for this drop, September and October of 1959 had been 21,672.

During January, February and March of 1959—months when all Cuban travel—Cuba's place among the world's airlines—international airports averaged 23% per month. In 1958, the airline's peak month of the year, January, saw a peak of 516 to 410 in February and 420 in March.

The figure would seem to indicate that although Cuba is a powerful aerial force, it is far more responsive to political developments within Cuba than are U.S. competitors.

#### BEA Reschedules Helicopter Service

London-Birmingham European Airways has delayed plans for scheduled helicopter service by one year. New scheduled date for introduction is the summer, 1962.

Report is that the airline has not yet decided which type of helicopter to order.

BEA spokesman confirmed that two U.S. helicopters—Boeing 105 and Sikorski, S-61—were being considered. The Boeing type is a twin-engine, 162 and the Sikorski Whirlwind. The boat-hulled Whirlwind is a development of the Sikorski S-61, and it is the first time BEA has increased its interest in the helicopter.

## SHORTLINES

■ **Allegiance Airlines** has been issued a route and denied under the Civil Aeronautics Board disavowing that the airline stop allowing persons other than the original passengers to use flight coupons from its "Book-Ticket Plus" Plan involves purchase of a book of 10 tickets between two points at a 15% discount. These World Airways, which has pending suits with Allegiance, filed a complaint with the Board charging that the latter carrier was permitting the transfer of flight coupons in person other than the original issuer to violation of the Federal Aviation Act. Allegiance agreed to accept the order.

■ **American Airlines** plan to begin nonstop Boeing 707-121 service from Philadelphia to Los Angeles as a daily basis beginning June 8. The helicopter transport will be operated with 44 first-class seats and 34 "Rural Coachmen" coach seats. Flight will leave Philadelphia at 6:11 a.m. and arrive Los Angeles at 6:40 p.m. Return flights will leave Los Angeles at 5:30 a.m. and arrive Philadelphia at 4:30 p.m. All times are local.

■ **Civil Air Transport** is opening a Western U.S. sales office in Burbank, Calif., on June 1. CAT will carry out of new offices to develop new airline sales in North American markets.

■ **Flying Tiger Lines** reports a net loss of \$81,688 for the nine-month period ending May 31 as compared with a net income of \$1,275,614 for the same period of last year. The all-time career attributes the drop to a 6% decline in passenger load which fell from \$15,585,672 last year to \$8,141,918. Air freight income increased 14%—from \$8,775,141 to \$11,114,701.

■ **New York Airways** reports that it carried 41,796 passengers during the first four months of 1960, a 45% increase over 1959 and a 110% increase over the same period of 1955.

■ **The International**, the airline of Thailand, a flying school near Detroit services, using Douglas DC-68 recently piloted by Scandinavian Airlines System carrier 345 has helped develop the Thai airline and will lead industrial assistance and air as its world-wide general sales agent. Initially, the Asian carrier will operate three weekly services from Tokyo to Hong Kong, two via Taipei connecting with few weekly flights over the route from Hong Kong to Bangkok. The airline also will operate three weekly flights from Bangkok to Singapore and Colombo.

## AIRLINE OBSERVER

■ **South Western** had made no response by late last week to a U.S. proposal that negotiations as a bilateral air transport agreement begin June 16 (AW Mar. 7, p. 7), and State Department officials now feel that it will be no immediate action in this area in view of the current strained ties. Originally, the Bureau wanted to meet with the U.S. to begin talks in April or May, but the U.S. was forced to set the later June date as a starting time for the talks because of previous conversations with other countries. Meanwhile, talks with Mexico were resumed indefinitely last week, after the U.S. refused to extradite to Mexico demands that request of U.S. citizens serving Mexico be extradited to permit a mass appeal of 200 cases of traffic between the airlines of the two countries.

■ **Domestic transline traffic** showed a sharp opening in April, giving strong indications that business has returned to the normal healthy level established in 1958 after experiencing a sharp dip in March. Revenue passenger miles in April were up 16.6% in comparison with a 12% decline in March. Available seat miles rose 9.7%—slightly higher than previous monthly increases. April's load factor was 81.21% in comparison with 80.75% in March and was the first increase since the past seven months.

■ **American Airlines** is studying their stage jet transports such as the Boeing 727 and the Convair Model 440 but having little interest in a jet for the present. American feels they offer no suitable advantages in expense or performance over its Convair 440s and the price quoted—probably \$3.5 million to \$4 million—was about as high.

■ **Capital Airlines** agreement with Convair to purchase a fleet of seven 440 jet transports is still in effect although the carrier has an aircraft on the manufacturer's production line. If and when the airline finds a way out of its current financial plight (AW Mar. 5, p. 18), Convair will build the planes and Capital will buy them. Agreement with Lockheed for the purchase of five Electra helicopter transports, also dependent on financial arrangements, has not been dropped. Lockheed has offered to lease the planes, which are now ready for immediate delivery by Capital markets, to the airline pending its ability to buy the planes but the carrier prefers to inform from any lease commitments until Vietnam-American friendship policies against it are revised.

■ **International Civil Aviation Commission** decided to reject the British Decca navigation system again because the subject of a hostile criticism in the House of Commons (AW Apr. 25, p. 41). According to the decision in favor of VOR/DME, was "political in defiance of the technical merits of the two systems." Duncan Sayers, Member of Aviation, expressed sympathy for this interpretation but maintained that Britain had decided to study the decision to prevent a backup of ICAO.

■ **United Air Lines** will operate its Self-Service in festival season when scheduled flights begin in August 1961. Although the Corvair will be used for self-service stage flights, United does not plan to operate it into other than New York's La Guardia Field or Chicago's Midway Airport.

■ **Domestic transline loads** generally pulled away sharply from 1958 last following the Civil Aeronautics Board price reduction announcement that the transline industry is entitled to an average rate of return on investment of approximately 15%. At end of last week, most carriers had filed, or were planning to file, for raising rate increases that would provide this return.

■ **Lake Central Airlines** has purchased four Convair 440 airplanes from United Air Lines for conversion to Atlanta 501-C11 helicopter engine which have already been constructed for which Allison Division of General Motors. Allison will handle the conversion which will begin in late 1960.

■ **Civil Aeronautics Board** will begin oral arguments this week on the appeal of a St. Louis, Florida route to Trans World Airlines which earlier had been rejected by a Court of Appeals. Board decided to hold oral arguments because of the "many controversial matters" involved and because only two of the five members of the Board who participated in the original decision are still with the Board.

# NEW BATTLEFIELD MOBILITY FOR CREW-SERVED WEAPONS

## WITH THE VERTOL 107

The twin-turbine Vertol 107, prototype of the army YHC-1A light tactical helicopter, is giving new meaning to an old word — mobility.

In "shoot and scoot" tactics for crew served weapons, the YHC-1A can swiftly transport three 106mm battalon air-bank rifles each with 4-man crew and ammunition. Terrain is no obstacle. Each crew and weapon can be dropped off at pin-pointed firing positions to ambush advancing armor with convergent fire. Within minutes they can be scooped up and redeployed to engage another target miles away.

With its rear loading ramp and unobstructed payload compartment, this helicopter has the ability to airlift a complete Little John system and crew, laying fire on a target 60 miles away 35 minutes after receipt of orders.

Vertol's advanced YHC-1A and the forthcoming YHC-1B (Chaseok), provide battlefield transportation which equals the advanced firepower of MoMAR — Mobile Modern Army.

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# Wherever Navigation News is Made

Edwards AFB, California, May 6—The public got its first glance today of the operational readiness and navigation-bombing capability of America's supersonic B-58 as the Hustler bomber simulated an inertial bomb run here before members of the Aviation/Space Writers Association.

CREW—U S 100 F0002

FORNER—CONWAY

NAVIGATION—SPERRY



Washington, May 10—The USS TRITON, world's largest nuclear submarine, today completed history's first underwater circumnavigation of the globe in 84 days, covering 41,500 miles.

CREW—U S 100 F0002

FORNER—CONWAY

NAVIGATION—SPERRY

## Airline Traffic—February, 1960

	Revenue Passengers	Revenue Passenger Miles (RPM)	Passenger Load Factor %	U S Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRUNK								
American	284,288	427,336	41.8	1,734,797	935,831	8,244,423	10,915,051	24.9
Boeing	170,475	79,334	31.3	240,423	142,442	8,420,364	8,803,229	19.8
Capital	124,617	104,244	49.4	444,340	199,284	998,673	1,642,307	49.4
Continental	91,891	28,371	30.5	141,149	175,072	173,459	4,716,486	28.4
Delta	340,738	118,483	37.1	290,001	327,618	1,192,914	15,294,803	47.9
Eastern	444,237	127,147	39.2	1,199,391	469,470	1,448,487	30,411,101	43.46
Norfolk	140,245	101,112	34.5	227,344	47,479	211,422	16,408,200	40.1
Northwest	100,472	11,427	38.9	101,204	34,609	11,914	5,111,194	48.74
Northwest	142,111	107,444	39.3	291,426	223,128	1,407,248	12,407,137	40.4
Trans World	156,293	370,561	37.9	1,474,448	734,264	2,171,714	16,407,344	40.6
United	444,854	319,491	47.9	2,193,803	941,129	4,107,509	29,794,034	54.2
Western	141,621	37,744	40.4	213,287	63,644	206,000	8,105,712	33.8
INTERNATIONAL								
American	10,917	12,818	40.1	8,153	100,000	1,407,348	74.4	
Boeing	4,484	3,249	40.8	20,744	120,200	1,444,447	44.2	
Continental & Pacific	34,244	0,444	40.9	1,444	7,145	100,159	49.8	
Delta	2,214	2,091	32.9	8,444	30,152	204,214	32.4	
Eastern	32,444	48,100	33.0	44,191	100,830	8,086,184	60.99	
Midway	12,444	2,304	40.8	4,444	3,415	107,159	49.8	
Norfolk	9,107	1,444	40.1	3,120	6,211	164,997	28.4	
Northwest	14,434	34,363	40.4	1,100,490	10,743	4,414,440	49.8	
Trans World	2,444	3,444	40.8	10,424	118,411	606,428	28.2	
United	49,100	161,260	40.9	1,218,411	2,490,437	13,407,418	50.2	
Western	103,104	119,119	40.4	100,444	4,001,444	14,404,114	40.4	
Express	39,444	107,124	70.8	1,399,204	1,762,441	14,104,114	60.4	
Panagra	11,399	10,108	40.8	70,411	820,439	2,440,148	40.4	
Trans World	14,500	43,500	44.8	913,810	1,114,814	4,104,449	40.1	
United	4,274	12,127	72.3	110,745	40,449	1,713,297	71.9	
Western	4,107	2,404	76.4	7,423	12,480	914,114	76.4	
LOCAL SERVICE								
Airway	36,004	4,104	40.9	11,473	20,344	27,473	603,409	29.8
Boeing	21,744	2,444	44.3	5,454	3,423	8,414	143,100	40.4
Continental	3,244	2,212	36.3	2,212	6,712	11,712	30,412	36.4
Delta	32,794	4,107	44.4	14,417	4,414	100,159	108,414	40.4
Eastern	14,807	3,271	36.3	4,374	14,110	279,419	40.4	
Norfolk	4,404	1,404	31.4	1,404	17,449	12,414	40.4	
Northwest	44,204	11,738	38.9	16,411	19,414	1,101,559	60.4	
Overseas	31,207	4,732	39.1	13,414	20,120	712,400	40.4	
Pacific	14,444	4,104	44.8	14,104	8,701	400,144	40.4	
Plaza	31,794	4,074	38.4	10,419	11,414	1,401,444	40.4	
Trans World	14,100	4,100	30.4	13,791	10,111	12,791	304,204	30.4
Trans World	20,607	4,493	30.1	17,499	18,809	22,343	104,414	29.9
West Coast	31,118	4,414	41.2	12,100	2,400	19,404	60,118	70.9
HAWAIIAN LINE								
Alaka	24,100	3,400	40.8	2,100	8,145	104,414	12.3	
Boeing	37,100	4,700	41.1	12,114	124,417	724,417	37.4	
CAROL LINE								
Alaka	4,400,154	4,000,154	40.4	4,000,154	4,000,154	4,000,154	40.4	
American & Pacific	2,100	14,100	100.0	70,104	40,104	7,100,147	10.4	
Boeing	2,100	14,100	100.0	70,104	40,104	7,100,147	10.4	
Continental	2,100	14,100	100.0	70,104	40,104	7,100,147	10.4	
Overseas	2,100	14,100	100.0	70,104	40,104	7,100,147	10.4	
Northwest & Western	2,100	14,100	100.0	70,104	40,104	7,100,147	10.4	
Alaka	2,100	14,100	100.0	70,104	40,104	7,100,147	10.4	
ALASKA LINE								
Alaka	9,704	189	39.6	39,240	3,786	109,640	1,943,953	28.0
Alaska	204,100	4,044	48.9	4,044	2,504	38,400	40,400	18.0
Continental	791	187	34.8	3,461	18,277	48,404	48,404	41.0
Delta	3,271	230	49.9	2,461	3,471	39,404	41,404	41.0
Eastern	411	361	34.8	3,461	18,277	48,404	48,404	41.0
Northwest	2,743	4,666	39.9	10,411	5,961	104,404	114,404	29.8
Overseas	1,514	612	38.8	3,461	18,277	48,404	48,404	41.0
Trans World	1,514	612	38.8	3,461	18,277	48,404	48,404	41.0
United	1,514	612	38.8	3,461	18,277	48,404	48,404	41.0

\* Not available. Compiled by NAVIGATION NEWS from airline reports to the Civil Aeronautics Board.

## New Methods Probe Space Flight Hazards

By Evert Clark

**Miami Beach, Fla.**—New techniques developed in recent months promise to increase the basic understanding of radiation damage and the effects of weightlessness, the two greatest unknowns in manned spaceflight, the Aerospace Medical Assn. was told at its 31st annual meeting here.

Radiation from interstellar space and from relatively near but intense solar flares now appears to pose the greatest threat for manned flight to the planets.

### Specific Damage

But, for the first time, specific biological damage done by a specific particle of radiation has been defined. That promises a detailed understanding of radiation damage to living tissue that has more implications in the study of aging, radiation effects on cancerous and non-cancerous cells and other areas of general medicine as well as a direct contribution to space medical problems. Lt. Col. David G. Sorenson told Aerospace Medical Assn.

Sorenson, as head of the biocountermeasures branch of the Department of Space Medicine at the Air Force School of Aviation Medicine, reported on studies done for USAF by Dr. A. Gita Delfick, of Florida State University.

Delfick's new paper indicated with broad brush and illustrated to members going to high altitudes by balloon. By

obtaining the ultra-ultra-thin track of a particular very heavy particle and correlating it with damage done to the blood vessel (microcapillary cross), Delfick was able to determine what damage a particular particle did.

Two groups of animal tests are involved, and Sorenson said it is believed that researchers can tell exactly which areas of which molecules are involved in the damage.

Further experiments with blood vessels, red blood cells and mice are to be made in a series of balloon flights scheduled to begin soon from Ft. Rucker, Ala. Flights are sponsored by USAF's Air Research and Development Command, the School of Aviation Medicine and the National Aeronautics and Space Administration. They also will give experiments of a number of researchers.

Shielding studies, including one done by J. W. Keller and N. M. Schaeffer of Geneva, P. Wirth for NASA, still indicate the need for very heavy shielding to protect a manned space vehicle against heavy solar and galactic radiation.

Both Sorenson and the Geneva researchers made it clear that information on radiation is still considered incomplete, and Sorenson said data reduction on radiation from satellites and probes already flown is lagging behind.

Right now, the major Van Allen belt about the earth appears to be trouble

for manned orbiting stations. Intensity of radiation in the outer Van Allen belt varies by a factor of at least 10 in intensity and by as much as 50,000 km in extent. Here, a vehicle can be shielded to prevent production of X-rays caused by the stopping of electrons and other particles that become the major problem, Keller and Schaeffer said.

Solar protons present up to about 12 days following a flare, but movements necessary last only about one day. These flares are occurring at the rate of about 10 a year now, but their frequency on other solar cycles is not known. In addition to these, outbursts of protons with energies of billions of electron volts have been observed since five times in the past 20 years.

Even if the point forces could be avoided by timing of flights and shielding would protect against those of lesser intensity, there still will be an area in between where it gets to be a very spotty proposition as to how big a chance one must take, Sorenson said.

### Weightlessness Effects

Understanding of the effects of weightlessness may be advanced considerably by a small gravity simulator now being completed at Lockheed Aircraft Corp's Marietta, Ga., plant. While it does not produce weightlessness, it is expected to depict some of the same conditions which kill body it is weightless—visual cues, proprioception, or "just

of the parts' sense of the body's position and orientation from the vestibule of the ear, which responds to both movement and position.

Dr. Richard B. Loomis of Lockheed Aircraft Corp. Operations Research Division and the simulator is based on signals put forth independently two years ago by generalist Dr. J. Mallet of Lockheed University, expert Otto Schindler of ARDC's Wright Air Development Division and Ralph W. Stone of NASA's space task group.

### Simulator Principle

Basic idea is to respond to a man in a rotating tank of fluid of specific gravity equal to his own, depriving him of most of his proprioceptive cues and visual indications of vertical or horizontal. Motion of the person into it is expected to rub the vestibule organs of the inner ear of the ability to tell the sense of his position or position in his environment the ability of those organs to respond. Experiments with fish were encouraging enough for Loomis to proceed to build a flycatcher device.

The company expects to use the simulator to study motion tolerance to weightlessness as ability to develop tolerance, ability of man to react to visual cues alone, effects of small head and regular accelerations on the vestibular mechanism, performance under stress and fatigue, work and rest cycles and sleep requirements, effects of drugs on these reactions, and effects of weightlessness on physiological processes.

Dr. J. L. Connor of the USAF School of Aviation Medicine's vestibular laboratory reported that experiments with rats indicated the vestibular mechanism has the ability to sense a change in position but will not continue to

provide firm information if the position remains the same only a period of some few minutes. While Dr. Connor indicated previously in the sensor organ and the circuitry through which it sends information to the brain and interests in further this further, he told to clarify. While that initial experiment indicates that man may well be able to adapt to weightlessness without the need for artificial gravity in open stations. Man appeared, can adapt to the vestibular state of the vestibular mechanism is not repeatedly sending information to the brain that indicates movement, Connor said. A few years ago, researchers felt that weightlessness might give man a sense of being in a constant fall with no feeling for it.

Col. Ralph N. Korman, from the school's Department of Clinical Medicine, reported that studies there indicate that it may be possible to train space pilots so they will have no undesired reactions to vestibular stimuli. Professional air pilots apparently have no undesirable response, and tests at the school indicate that the duration of the response of a group of pilots to these stimuli was shorter than that of novices.

Dr. Carl G. Clark, head of the Biophysics and Biomechanics Division at the Aerospace Medical Association Laboratory at the Naval Air Development Center, reported that he lived, ate, drank, slept, read, talked and wrote in a 24-hr. role in the Johnson counter flow at a constant acceleration level of 2.6.

Radiation diseases generated by rapid rotation of the head were mentioned, a point which Clark said had not been considered in most design for rotating manned space stations.

Two hours after starting the test, Clark walked a few steps in the simulator, but, when he tried the same thing 32 and 34 hr. after starting, he had a feeling of peripheral numbness and some nausea. He said that nausea must be developed in vestibular reactions, and other mechanisms before being changed acceleration level or attitude.

In the first two hours Clark had abdominal discomfort and a mild frontal headache. Again, reduced both symptoms. Soreness began after the start of the test, an unconscious sensation developed in the ring and little fingers of his left hand. Some tingling numbness occurred for about two months after the experiment.

While blood count increased from 11,100 to 22,000 per cubic millimeter, a flicking of highest level for approximately one half hour after the centrifuge stopped. An abrupt blood count 10 min. after the test was considered normal.

Clark concluded that tolerance to the 12 revolutions per minute of the centrifuge for 24 hr. was achieved only by increasing head motion and that tolerance to 2g was achieved only at the price of reduced acceleration, finger numbness, water retention and increased blood count.

### Apparent Risk

USAF Lt. Col. John A. O'Connor, chairman of the Atomic Energy Commission's Aerospace Nuclear Safety Board, said at a "hazy, unemotional approach" of the risks involved in the nuclear powered, weight, rocket and nuclear power generators is "no more than, and usually less than, risks encountered in the progressive development of space and nuclear power."



**MEMBERY** in plastic box (left) handles oxygen produced synthetically by closed ecological system at USAF School of Aviation Medicine. Experiments are made (right) at the school for an experiment in which learners are exposed to simulated Martian environment.



**SCALE MODEL** of roll gravity simulator (left) being built by Lockheed shows how man will be placed in rotating tank of water to simulate weightlessness and be observed. Two closed ecological systems developed by USAF School of Aviation Medicine are at right.



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STANDING TANK of water would simulate roughnesses as shown in drawing of race simulator Lockheed Aircraft Corp.'s Human Factors Research Laboratory. Manette Co. experts in live air operations soon helped suspended in the tank of water would be observed to determine his response to operating tools and the artificial environment.

the airplane, the astronaut, or even something as basic as fire.

To allow for these risks, however, it's quite usual safety measures. Testing of the Plate reactor for the Star one will require an enclosure area of 1.4 m. from the launch site for a cold launch and 5.1 m. for a hot launch.

### Exclusion Area

100 miles outside the exclusion area there should be no more than 500 population and the total population should be less than 5 per square mile.

100 to 20 miles outside the exclusion area there should be no more than 1,000 population and a total population less than 10 per square mile.

Star's center will be essentially shielded so that direct radiation to a person directly beneath the flag would not exceed the maximum allowable dose in a lifetime dose, which is divided into four tests over the seven 1000 kilometers above 75,000 ft., should drop to a percent on the ground is negligible.

Excess released during flight at 100.



EXPERIMENT at USAF's School of Aviation Medicine indicates that man can not need artificially induced growth to function in a space station. Variables of the air which were changes in growth, apparently adapt itself quickly and does not continue to feed "down" adaptation in the lower of the one condition remains steady. Experiment done by taking an astronaut on and increasing the response in a single cell of his bone also indicated that probable zero-gravity flight should be more than 100 sec. duration of this can be 100 working more than the total response to weightlessness.

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thrust above 500 ft will be within feasible limits for the general public use. But in the event of repeat on land as cushion index of 55 in will be required for all-size personnel. O'Connor said this makes the need for a board even less urgent, almost.

Most of the known products from a Rover test transfer nuclear rocket would remain in the shockless rocket and the few gases that diffuse through walls of the reactor's fuel cells will readily diffuse with the atmosphere, O'Connor said.

Reactor-type rocket could be launched from coastal regions if low conditions to meet, O'Connor said. This includes having the reactor only after it is in a stable orbit and only if it can be burned up with wide dispersion and if no one has decided to an acceptable low level.

Not enough is now known about rockets to control it precisely or to be certain the reactor would be destroyed he said. The same problem applies to nuclear reactors, power reactors if they are used in earth-orbiting satellites.

Capt. M. H. Goodrich of Navy's Bureau of Medicine and Surgery said preliminary data from tests with the McDonnell F4H fighter during recent carrier suitability trials indicates that the aircraft's subjects the stress equivalent to twice the same that the Chance Vought F8U Corsair did when it was introduced in 1950. This is a maximum lag load with no control and is of "transcendent significance," Goodrich said. It means that operations with deck-edge operations such as catapult operations eventually will need sound medical means, and officers are not likely to be in immediate jobs such as attaching a catapult hook to an aircraft.

Wave level on the flight deck has become so high that at times even the crew warning status could not be heard. Goodrich said. One test subject recovered in car seats did not solve the problem but two was radio helms here, he said.

J. J. Kankoff of the Space Sciences Laboratory at General Electric's Missile and Space Vehicle Department reported on an experimental engine a generation earlier that would produce more than a man's daily requirement of oxygen by recombining oxygen from carbon dioxide and water vapor exhaled from fluid and solid body wastes and propellant. Kankoff on an astronaut out who became interested in life support systems believes that such a system, using a variation of the Fluids Transport system, could be kept in a weight of 120 lb.

This system appears to be the most desirable for any period exceeding one man month, he said.



## These are men you should know DELAVAN FUEL INJECTOR SPECIALISTS

Their names are Robert Fried and John Edstrom. They're Delavan Fuel Injector Sales Engineers. Both are fully qualified to discuss the technical aspects of fuel injector applications. Bob Fried holds an E.E. from Brown State U. and has had six years of jet engine experience. John Edstrom has a B.S. in General Engineering from Iowa State University and over eight years experience as a sales engineer. These men are ready to come to you. They and the staff of project engineers and production specialists at Delavan are the men whom leading turbojet, turbofan and APC manufacturers rely on Delavan for fuel injector production selling.

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**FIRST**—independently oriented navigation

**FIRST**—independently oriented photography (Able and Baker)

**FIRST**—precision First World space probe



Ballistic missile

## New Project to Study Combined Airborne Display of Radar, Infrared and Photo Data



Five Instrument engineers have a company map with aerial photos. Sensor integration study includes psychologic standard analysis, photography and photography as well as radar and infrared detection video tapes.

Methods for airborne integration of information received from the most commonly used types of reconnaissance sensors—photographic, radar and infrared—are being developed by Ford Instrument Company under Air Force contract to the Wright Air Development Division.

The new study contract, one of the largest ever awarded by Ford Instrument in the field, concerns the processing work previously done by this company on the subject of integrated sensor interpretation. That topic, this work was assigned psychologic and radar, aerial field tests at Ft. Belvoir, Md., and developed Air Force Blue Book and secretarial analysis. The results of the studies are classified. Their present assignment is to conduct defense industry studies in order to determine the need for such data in the future.

Each of the three types of sensing devices—radar, infrared and radar-infrared—has advantages and limitations.

For instance, radar provides reliability

picture in good weather. However, the identification of a particular target frequently can be facilitated by use of infrared and radar information in addition to the aerial photograph.

Infrared sensors are especially good for detecting data on an object whose shape differs in color from that of its surroundings, and can be light sensitive photographic equipment, infrared sensors can be used at night under special optical systems. For these reasons, an operating plan shows up much better than the same plan side, but the quality of the picture does not compare in detail with an aerial photo.

Radar, like infrared sensors, can detect detail, but has the advantage of working at any time of day and in all but the worst weather. It is particularly effective for detecting metallic shapes and structures.

Ford Instrument engineers are developing methods for combining data from two and possibly all three, so the system can provide a display which contains more information than any sensor alone provides, and which can be interpreted quickly and accurately.



Radio. Ford Instrument engineers study the production of experimental thermionic and light. Using nuclear or solar energy for heat, thermionic converters are an alternative power supply for satellites and space vehicles.

## Study Shows Thermionic Power Close at Hand

Thermionic studies now underway by Ford Instrument laboratories indicate that a new low field power generation is being opened up. First-generation model thermionic cells, the most common of heat ion-electronic have been built in studies which provide surprisingly high current densities at moderate temperatures.

Investigations indicate a wide variety of practical applications, including small portable units to serve as generating sys-



tems for the feasibility of launching spacecraft, one critical in the field elements of nuclear reactors, the use of fuel cells and solar energy for thermionic conversion, and the construction, study and evaluation of numerous thermionic cell types, particularly for operation at moderate temperatures.

Investigations indicate a wide variety of practical applications, including small portable units to serve as generating sys-

tems for land-based military, aerospace applications, such as power generators and control equipment, and a large number of other data applications.

In addition, the thermionic converter, because of its simplicity, compactness, and low maintenance, is believed to have a nearly ideal electrical power source for satellites and other space vehicles, using as a source of heat either solar or nuclear energy.

## New Data Transmission System to Aid Air Traffic Control



Airborne equipment Center Decoder Group 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

Following existing instrument recorder type lines in equipment, a system designed to augment present air traffic control facilities. Both ground and military has put completed evaluation tests at Mather Air Force Base, Long Beach.

The equipment, designed and built by Ford Instrument under Air Force contract from Kansas Air Development Center, uses high data rate digital transmission on a time-shared basis to obtain flight data from

currently assigned aircraft. The present equipment handles information on aircraft altitude, air speed, and magnetic heading. The system completely handles location, and future developments can include velocity data or other data transmission from ground to aircraft.

In addition to offering speed and accuracy for on-the-ground data, the system is readily adaptable to military use.

Mather Air Force Base was chosen for prototype evaluation tests because of its location within the congested New York area. Twenty instruments Airport there handled 150,000 planes in the first eight months of 1959.

Reference pictures of the new equipment are extremely compact and lightweight—some weighing less than one pound and some weighing less than one ounce—weight that they are portable. Each data converter weighs approximately 40 pounds and weighs just over 2 pounds. The electronics unit has a volume of less than 1 cubic foot (14 1/2 x 21 1/2 x 12 1/2 inches) and weighs just under 50 pounds, including the rack mount.



Dr. H. Schwartz, Chief Engineering Scientist for Special Weapons at Ford Instrument, and J. K. Kautzman, project supervisor at Ford Instrument, examine aerials having device after flight into outer space and recovery from orbit.

## New Fuzing Contract for Ford Instrument

The Ford Instrument Company has received a \$1.3 million contract from Robert Research & Development Laboratories, Inc., to develop and produce a fuze device for the Army's recent warhead, the M549.

Ford Instrument has had wide experience in fuze development work. Notable completed activities include safety fuze and timing devices for atomic weapons and the fuze device for the J-1000 missile (see photo). The M549 fuze program is under the technical direction of Precision Aerial.



## Additional Aero Navigation Contracts Awarded



U.S. Air Force Photo

In the past six months, Ford Instrument has been awarded approximately \$5,000,000 in additional U. S. Air Force contracts for AN/APN-111 systems, computer units and test equipment. The AN-111 is a deadweighting, course and distance computer system being used in KC135's, F100 F's and other aircraft to provide extremely accurate navigation.

## Flight Control System is Tested At Ford Instrument Facility



Ford Instrument engineer adjusts control on panel of the AN/APN-111 Flight Control System, during test at company facility. At right is target on which radar is focused. The AN/APN-111 developed under the direction of the U. S. Army Signal Research and Development Laboratory, is designed to control combat aircraft through an eight-deep over enemy territory.



ing, to locate and control their own forces by means of cameras, TV, infrared and other devices for locating the position and movement of troops and materials, and to transmit data from the vehicle to the ground.

The AN/APN-111 system includes the control trailer shown, as well as other ground-based and airborne equipment.

## New Multi-Channel Data Converter



Ford Instrument engineers check performance of first experimental data converter model.

Both by Ford Instrument Company, an affiliate of Ford Instrument, which has an extensive space program, and a digital output has successfully completed evaluation tests at Naval Electronics Laboratory, San Diego, Calif. The latest equipment can be packaged into less than one-half cubic foot, making it ideal for use in missile applications.

Styled the "universal virtual data converter," this design can also be adapted to handle inputs in the form of a sine wave and complex waveforms.

Several important concerns have previously been taken into account, to perform the con-

version capable of being handled by the new device. This is the first time that a single, self-contained unit has been able to accept inputs of widely diverse nature. In addition, the new device can be made to translate digital output information back into analog form for automatic analog-type servo and control systems for such applications as aircraft flight control, missile launching and guidance, and in thermal control systems.

Ford Instrument engineers, who have been working on the problem of data conversion for the past six years, started work on the new converter in 1957.

## We invite you to learn more . . .

Responsible agencies or industries, possessing the require to security clearance and need to know, are invited to learn more about Ford Instrument capabilities. Ford Instrument Division Engineers are always ready to discuss your use or special requirements, and will be glad to provide you with detailed information on specific project capabilities.

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A BRITISH TEAM OF SCIENTISTS, ENGINEERS AND PRODUCTION TALENT

# MANAGEMENT



LOCKHEED is manufacturing 50 F-104Gs for West Germany, which will build hundreds more. Canada will build the CF-104, and Japan the F-104J, under licensing agreements. Netherlands and Belgium also are working out F-104 licensing agreements.

## Lockheed Diversifies for New Markets

By Russell Hovkes

**Burbank, Calif.**—Sales of aircraft accounted for less than half of Lockheed Aircraft Corp.'s total sales in 1959 for the first time in its company's history. The trend is being perpetuated in other companies within the industry.

Conservative diversification is the way Lockheed officials describe their version of the drive for new capabilities and markets. The term refers to the expansion of existing product lines and capabilities and the establishment of technically different ones.

Reinforcement of corporate capabilities to fit a rapidly changing competitive picture has demanded a serious pace of Lockheed's conservative diversification. In the past 15 months, three subsidiaries have been acquired, two more have been created out of existing divisions and subsidiaries have been made with two design firms and one domestic firm. Reasons for this and estimates of the future course of the program were outlined to AVIATION WEEKS IN, by Dr. E. Bremer, Lockheed vice president in charge and Dr. Agor, head of the corporation's Development and Test Dept.

The product that the pace of Lockheed diversification was due down speed, diversification was needed at first to catch up with the pace of technology and related changes in defense contracting patterns. The predicted

slowdown will not result from lack of interest in further diversification, but because Lockheed experts are convinced that time is needed to assimilate the acquisitions already made and allow time to adapt itself to new aerospace abilities.

### Thorough Planning

Thorough planning and anticipation of trends are expected to prevent rapid fire bursts of diversification such as the

company has just experienced. Thus technological breakthroughs can be forecast to some extent and included in corporate plans.

Though specific evidence of intense diversification may be needed, says Lockheed officials are beginning to feel that the high rate of technological advancement now, demands increasing diversification. However, they have noted a trend in the corporate board of directors of progressively smaller

## Lockheed, Kaiser to Build Azcarate

When Lockheed Kaiser Argentina has been established as an equal partnership between Lockheed Aircraft Corporation and Lockheed Aircraft International, a subsidiary of Lockheed Aircraft Corp. The new plane manufacturing company in Argentina is to work with a design signed recently by Argentina's President Peron to encourage Argentine industrial development.

Initial product will be the light single-engine Azcarate which is specifically designed by Lockheed Argentina under Lockheed Aircraft, and is built by the newly formed Argentine-Mexican Lockheed partnership (AVI, p. 25 p. 95).

When Lockheed Kaiser will start with a working capital of \$2 million, established equally by Lockheed Kaiser and Lockheed International in cash, equipment and facilities. A new factory will be built adjacent to Lockheed Kaiser automobile plant in Cordoba, a city of 300,000 population about 400 mi. northwest of Buenos Aires. Production of the airplane is scheduled to start this year. Several hundred persons will be employed when production gets under way.

The new airplane, whose prototype was first flown at Lockheed's Georgia Division last September and exhibited by Federal Aviation Agency last month, is an all-weather, high-speed transport carrying 30 persons or about 1,000 lb. cargo (see p. 67).

Lockheed Kaiser is 50% owned by Wilbur Mahon, Inc., a Kaiser subsidiary. About 50% is owned by the Argentine government and the remainder by private Argentine largely Argentine.

## Knowmanship in Action



What first was new and innovative was discussed and demonstrated at Eclipse Pioneer's recent cost conference held with representatives of the five major aircraft manufacturers and 50 of U. S. P's subcontractors and suppliers.



*Bendix cost conference reports*

## IMPORTANT PASS-ALONG SAVINGS

*on F-105D Air Data and Instrumentation Systems*

Spelled out to B-E vendors were advanced techniques that shaved significant dollars from the manufacturing costs of Air Data Computer Systems and Vertical-Scale Instruments for the USAF's Republic-built F-105D Thunderbolt.

Objective was to stimulate B-E's vendor organizations into similar types of cost reduction effort.

One successful for cost-saving technique presented was the use of "electronic instruction" on the assembly

floor. These novel audio-visual aids—individually controlled by each assembly worker to his own learning rate—reduced total man requirements by 80%, cut learning time in half. Another technique discussed was the replacement of point-to-point wiring with prefabricated harnesses to improve quality, reduce assembly time. Other savings asked came from the use of close-range slow-motion pictures to seek out "lost motion" in assembly operations, from the use of tool standardization and material han-

dling innovations, and from the use of standardized data. All added up to an effective demonstration of how B-E knowmanship has served—and is continuing to serve—military for Republic, the Air Force, and the taxpayer.

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**FLIGHT RECORDER** (above) is built by Lockheed's Special Devices Division and automatically produces permanent, continuous and legible record, and is used in Boeing 747 jet transports. At right is the Lockheed Annapolis Model 601 safety plane.

companies to fill corresponding needs in their capabilities.

One of the meeting topics behind Lockheed's demonstration was the reduction of defense contracting patterns caused by the weapon system concept, progress in materials and the scientific work of airframe assembly to hold specific systems only. These contracts would go to the company responsible for the most critical element in the system.

The first big guided missile was an exciting event, similar to the North American, Convair, Vought Republic and Martin Mariner. This became a major K-1 to K-1000 aircraft company, a major missile and aircraft company. This could not be said of smaller missiles and the first big, ballistic missiles. For the first time, Lockheed and the other old-line airplane makers found themselves, being outside competition, outside from electronics firms.

### Avionics Importance

Most of the first language, ballistic missile program contracts came to the aircraft companies because the military did not immediately appreciate the increased importance of weapons and the local demands for the world-leading skills of the aircraft companies.

The situation called for quick adjustment of the companies' capabilities. In March, 1951, Lockheed Electronics and Avionics Division (LEAD) was organized as a separate entity, but active critical skills were still being lacking. In May, 1951, Lockheed agreed to acquire Special Engineering Co., which became a wholly owned subsidiary in Systems Inc. Though a small company, Special had built a respectable reputation for its work with advanced radar. In December, 1951 and 1952, LEAD was joined to form Lockheed Electronics Co.

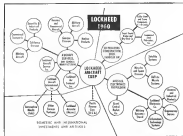
Lockheed officials foresee the day when propellers will replace ductless engines and propellers and control electronics in the vertical field in missiles and space technology. This was behind the announcement that Lockheed would purchase a 50% interest in General Coastal Rocket Co. The dual of missile success assigned to electronics is expected to remain high, but as electronic engineers perfect their art, companies officials anticipate a trend back toward old-fashioned purchase of electronic components and sub-systems.

The decision to buy Page Sound Bridge & Dry Dock Co. of Seattle, a shipbuilding firm, was due partly to the observation that a large part of the missile budget is being assigned to launch complex construction, especially of the

bases are hardened. The Seattle firm has considerable experience in heavy construction work.

The Lockheed announcement of plans to acquire Collins Steel and Crane Co. is related to the purchase of Page Sound Bridge. Collins plans in Seattle and Vancouver fabricate steel structural components under subcontract for assembly in the Page Sound Bridge shop. In the future, Lockheed plans to move Collins under the same roof with Page Sound Bridge, so that fabrication and assembly will have a single integrated operation.

Lockheed officials say the Page Sound acquisition now appears even wiser than it did at the time it was made. They anticipate that heavy engineering will receive increased work.



wide diversification—both in the U. S. and abroad—is shown by the diversified chart.

## THEY RELY ON RADIATION

for missile range  
instrumentation

In 1954, the Air Force called for a more efficient means of missile range instrumentation. The Atomic Missile Range Test Station—long-range automatic testing of missiles in flight.

Instead of war the challenge with what was then a bold new concept in range instrumentation. The heart of the sophisticated new system was a different capacitor track system in flight. The system's job was to high speed a precision tracking the number of charged elements along the missile's path in flight.

Subsequently receiving Air Force requirements, these systems have paid it in results to previous experimental ones from Newport, Kansas, England and then.

Two of the systems were selected in the Air to Atomic Range to meet an accelerated testing schedule.

**RADIATION** is a leader in space electronics. The Company has engineered, developed and produced complete sensor and communication systems for NASA, AFSS, USAF, USAF, Navy and Army. Many products designed and built the sensors at Texas Road, Hawaii, and installed the P. Missouri sensor for the first nuclear satellite project. The first FM transmitter is another product of Radiation.

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Radiation is a group of companies and divisions: Florida, Missouri, New York and Palo Alto, California.



**LOCKHEED's** head chairman, Robert E. Gross (left) and W. A. Fisher, Georgia Division vice president and general manager, inspect test cells in Norton Research Laboratory at Huntsville, Ga., as transport-controlled manipulators slowly submerge effects. At right, workers load Nike Zeus nuclear warhead, made by General Electric Co., prior to lowering it into an underground storage area where payload will be posed into its ball chamber.

will become a big and highly profitable business. Lockheed's Nuclear Products Division has built nuclear.

Lockheed's California and Georgia divisions are both interested in the vertical lift ball California Division is working on the CL-170 lift using turbo-prop Aero-Union plane and a helicopter. A prototype of the helicopter crashed recently in flight test (AVW 21, p. 37). The two-engine CL-379 is being designed especially for its use with work with ground troops. No engine market is known, though the same principle could be used in civil aircraft.

Georgia Division has offered Army a proposal for a biplane VTOL aircraft using jets deflected through the fuselage section from a pair of turbojets located at the wing roots. That is, as suggested in outlining concept as through lift on the fuselage, top Propulsion system is modified over to forward thrust by repositioning the deflector valve to direct exhaust gas through the engine nozzles.

### Lightless Field

The corporation is exploring the lightless field through Lockheed-Aerotech, a Western affiliate and Aerotech's Memphis, an Italian firm in which Lockheed is having a substantial interest in recent NASA 66, light adds aircraft to the list by Lockheed-Aerotech, was designed by the California Division.

Georgia Division is being to sell the Super Falconer stretched version of USAF C-130 cargo transport to civilian airlines (AVW 16, p. 18) but competitors believe the air cargo market will not achieve its potential until

ground handling delays and costs are reduced. California Division is testing a solution.

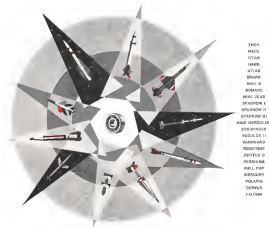
An aircraft, among Lockheed's aircraft and affiliates is Pacific Finance Co., which was acquired in 1946 with an eye to financing a loan for small aircraft, then domestic. When the loan failed to materialize, Pacific Finance decided to increase largely its automobile and house loans, making it the single even

pl. of non-consumer diversification in the Lockheed stable. It is expected to serve as a lever for the Lockheed-Aerotech NASA 66 program, coming into its planned role (AVW 16).

The term, consumer diversification means setting up new organizations to improve competition in fields at the edge of the company's existing capabilities. For instance, an aircraft manufacturer naturally develops some



**TRACKING** antenna was designed and built by Lockheed Electronics Co.'s Military Systems Division at Pleasanton, N. J. Antenna is an advanced technology contribution to the area of long range missile detection and high ground radar.



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TITAN  
HAWK  
ATLAS  
SHARPE  
NAZ-4  
ROMANTIC  
MINE-DEAD  
SPARTAN I  
SPARTAN II  
STARROW III  
NEW HORIZONS  
SOLWIND  
ROSLAR II  
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## Dassault Mirage IV Strike Bomber Prototype

Three preproduction Dassault Mirage IV Strike Bomber prototypes have been ordered by the French government. All will be powered by two An-9 turbojets. Deliveries are scheduled for 1963 (AVR May 2, p. 147). Government estimates place the order at \$60 million.

complexities in systems and a missile airframe builder actually learns more about problems. Conversely, its simplification is to form specific requirements based on these perceived capabilities and market then outside the company. By so doing a new, order philosophy of capabilities and markets is built, setting the scene for a new round of expansion.

Lockheed is strongly identified with its products, as are the other old-line airplane builders. Because of this, its diversification program is a process of broadening product lines. It will not become a holding company.

Lockheed effectively took the recent two diversification routes because the policy in a merger can get over low technical production or administrative power from each other if their operations are closely related. Then apply the term "synergism," is often pattern of diversification. The word refers to a process of acquiring or creating new companies for their profit or financial stability without regard to operational ties. The result is a stable profitable conglomerate of all unrelated products and capabilities.

Lockheed executives list three reasons on the economic diversification there and have used all of them. They are:

- "Buildup" of a new or peripheral capability in addition to the existing skill and constructing new facilities.

- "Spindoff" of internal departments or groups to form new divisions or subsidiaries when their strength, size, and the external market for their capabilities justify the action. There are advantages in absorbing specialized or related units to specialized product groups while

during general overhead costs at the corporate level. There are also advantages in segregating functions from multi-plan-level for operations and separating technical staffs which serve all facets of the company.

- Acquisition by merger of outside companies with related operations.

Acquisition of outside companies is the quickest and probably the most rewarding of the three, but it also is the most complicated. To find and evaluate potential targets, Lockheed created the Diversification Task Force. The task force reports directly to a policy committee headed by Robert C. Gross, chairman of the board.

### Critical Skills

Decisions to consider possible mergers or units of related skills for entry in a desirable new field are based on the lack of existing divisions. Task force objectives is to examine the needs of the corporation, search industry for merger opportunities, evaluate alternatives and establish a strategy, composed of broad rules for selecting the right alternative. If the task force recommends acquisition of a company, the policy committee will appoint a negotiator from the top echelon of the corporation.

By itself, reports there is no simple, objective yardstick by which to measure the wisdom of acquiring a particular company. A minimum of 20 financial ratios and other are used in the analysis but the final decision rests heavily on the business insight of corporate officers.

One criteria which can quickly set possibilities of acquiring a large company in its price-to-earnings ratio. If the ratio of price to the open market is earnings

per share is much higher than Lockheed's, an exchange of stock results in a dilution of earnings on Lockheed stock. The Lockheed price-earnings ratio is typically around 7.5. Earnings comparisons are made around 20 and most manufacturers may be as high as 100. Lockheed executives call the stock of high-urban companies "Chinese money," because of its low value in an exchange of stock. High urban discount earnings for the future. The low price-earnings ratio of stock companies such as Lockheed is obviously a troubling block in a diversification program.

The two other most important factors are profit margins and the degree to which the new company's operations would fit in with those of the corporation. If the fit is not actually possible in respect other than financial, Lockheed usually will not be interested. The Policy Board and the Diversification Task Force have turned down deals, profitable mergers for fitting to fit into the concrete diversification picture according to the board.

However, says Lockheed must grow to keep the company's best employment opportunities for advancement, or the firm can expect to lose them. It also must gain to make its stock attractive to the public and to attract leaders. Because quotes a study which shows that the 45 leading corporations in the country scored a steady 9.9 per cent growth in sales.

Expansion is necessary for growth because Lockheed's technological growth is limited. The military services, permanent airplane buyers for 20 years, no longer provide a market which will support the desired growth rate. Under this present constant level-of-de-



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## AVIONICS

### Arinc Unveils New Avionic Reliability Data

By Philip J. Klass

**Durham**—New data for advanced prediction of avionic equipment reliability, which reveals that reliability falls off more sharply than previously thought in equipment complexity increases, was unveiled here during the recent National Aeronautics Electronics Conference (NAECON).

Analysis of data for a variety of airborne display and ground-based equipment shows that the relationship between reliability and complexity is not a linear one, George T. Reed, Arinc Research Corp., reported. Arinc Research Corp. specializes in reliability problems.

His means that while a one-tube no-burn analog type system will operate at average 21,700 hr. before failure, a 1,000-tube system can be expected to operate for only 2.2 hr. before failure, not 21.7 hr. as previous theory suggested. The foregoing figures are based on a design without redundant circuitry.

#### Prediction Formulae

Analysis of data on reliability of a number of different airborne, display and ground-based systems in field use, collected by Arinc, Bell Telephone Laboratories, Wirtz, Radio Corporation of America and others, indicates that the following "complexity dividing" should be employed in predicting the mean time-to-failure (MTTF) of electronic systems:

- Airborne: MTBF = 21,700 (N)<sup>-1.5</sup>
- Ground-based:

MTBF = 357,000 (N)<sup>-1.5</sup>

The factor "N" is the number of non-redundant "active element groups," called "AEGs" for short. An active element group consists of a tube or transistor and its related circuit components.

For example, an AEG for a transmitter and equipment consists of one transmitter, plus one diode, three capacitors and two resistors. In addition, the AEG includes the following: signal (the source) per 1,000 transistors; 50 in. diodes; 10 power transistors and diodes; 10 RF and pulse transistors; 10 meters; 35 relays; 100 variable resistors; 100 switch contacts; 20 pins and plugs; 10 receiving-type vacuum tubes and two special purpose relays.

The reliability prediction chart, called a "scattergram," which Arinc has developed shows the actual reliability experienced in the field for a number of military equipments, whose design age ranges from two to 10 years, Reed said.

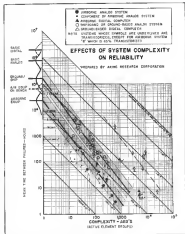
These equipments a variety of types, ranging from airborne bench-top signal systems to ground-based communications receivers.

The Arinc scattergram shows the average, or "true average" failure rate per hour (ARF) when used in analog systems. This ranges between one and three failures per million operating hours, with an estimated mean of 3.3 failures per million hours. This figure means that parts whose deterioration patterns are Gaussian are replaced by percentage (multiplication) before actual failure. Also, that initial design design

has eliminated the "maverick" or "outlier" problem and that parts testing has eliminated the initial defectives, Reed said.

Preliminary data on digital-type equipments indicates that they will have a somewhat higher basic reliability (average failure rate) than the basic analog type circuit, Reed said. However, the data is not sufficient to establish a basic digital data rate, although the preliminary estimate is closer to that of the Arinc scattergram.

Ground-based equipment experiences a mean failure rate of 3.3 failures



per AEG for predicting reliability of various equipment, based on actual field performance of a variety of airborne, ground and display equipment, shows that reliability falls off more sharply with increasing complexity than previous theories indicated. Reliability of military mission equipment is expected to be comparable to that of ground/display equipment. Scattergram was prepared by Arinc Research Corp.

# FOR RELIABILITY UNDER SHOCK LOADS AND HIGH HEAT...SPECIFY MIDVAC STEELS

Where metal parts must stand the sudden shock of heavy loads, as in plane landing gear... or the high heat of jet engines Midvac Steels offer the answer. The Midvac Process of consumable electrode vacuum melting produces metals with increased tensile, higher impact properties, improved stress rupture strength at elevated temperatures, and longer fatigue life.

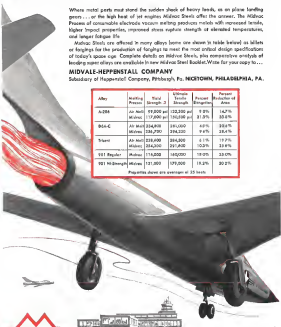
Midvac Steels are offered in many alloys (some are shown in table below) as billets or forgings for the production of forgings to meet the most critical design specifications of today's space age. Complete details on Midvac Steels, plus comparative analysis of leading major alloys are available in New Midvac Steel Booklet. Write for your copy to...

## MIDVALE-HEPPENSTALL COMPANY

Subsidiary of Heppenstall Company, Pittsburgh, Pa. **NORTOWN, PHILADELPHIA, Pa.**

Alloy	Melting Process	Tensile Strength - 2	Ultimate Tensile Strength	Percent Elongation	Percent Reduction of Area
A-286	Air Melt	95,000 psi	122,000 psi	9.8%	14.7%
	Midvac	117,000 psi	150,000 psi	31.5%	35.6%
904-C	Air Melt	254,000	284,000	4.8%	39.9%
	Midvac	238,700	274,200	9.8%	28.4%
Ti-6Al-4V	Air Melt	218,000	264,000	6.1%	19.7%
	Midvac	264,000	297,000	10.3%	33.6%
V-61 Regular	Midvac	176,000	180,000	19.0%	33.0%
V-61 Hi Strength	Midvac	131,000	179,000	18.3%	30.2%

Properties shown are averages of 25 tests



# Midvac Steels

tons per million hours of operation, considerably lower than the 45 failures per million hours, both for a single (low) AEG. The failure rate of airborne equipment when operated under load conditions is roughly midway between ground shipboard and actual airborne failure rates.

The Avionics chart shows the "complexity desiring" which must be applied as the number of AEGs increases in the form of consolidated loads. These drop off more sharply than the theoretical rates for a 45 deg angle previously used in predicting equipment reliability.

## Adjustment Factor

One reason for the fall-off in reliability with increased complexity, Bird speculates, is that increased complexity usually results in an increased number of loads and other adjustments by which the operator can compensate for deterioration in performance or degradation of individual subelements. As the number of such adjustments increases, the burden on the human operator is increased and he is less able to react effectively and timely action to correct the deterioration.

Although only limited data is available on the reliability that can be expected in satellites and space vehicles, it indicates that the failure rate will approximate that of ground-developed equipment, Bird said. This is substantiated by statistics on the basis that the environment in space should be relatively favorable, with no sudden or large changes of temperature, no shock, or vibration, except for the initial launch conditions.

## Future Satellites

Because of payload limitations imposed by rocket booster power, most satellite equipments have necessarily been limited in their complexity. With the advent of larger boosters, and the many sophisticated payloads they make possible, designers of satellite mission equipments are going to run headlong into the "complexity desiring" factor.

If satellite payload capability proves comparable to ground/shipboard equipment reliability, a reduction of 100 AEGs complexity approximately 71% total components, can be expected to equate for only about a month. This, in terms of complexity, is roughly the equivalent of a 100% improvement rate.

Assuming that a communications satellite can be built with a complexity of around 100 AEGs, a 10:1 or greater improvement rate in reliability would be needed to give it a useful life of one year.

One partial solution, Bird pointed out, is the use of redundancy in payload design. That is providing one or more backup circuits or subsystems

**SAVED: 120 Hours of Useful Engine Life**  
**COST: 77¢**



A leading corporate operator was having oil pressure drop and propeller operating difficulties on one of the Airwork overhauled engines on his DC-3. The problem, to the operator's point of view was serious enough to justify ordering the engine removed from service some 120 hours before routine schedule.

The pilot called Airwork for an exchange engine. We called one of our Field Service Engineers, asked him to check on the problem. He was on hand the next day and pinpointed the difficulty to a damaged propeller oil transfer and. Three hours later, that airplane was back in operation and the engine ran out its full service life without trouble.

Airwork has three Field Service Engineers. Service Manager Bob Scott at Millville, Field Service Engineers Neil MacLachlan in New York, and Tom Tansler in Cleveland. These men cover the East, working with customers to help them get the full measure of trouble-free hours built into every Airwork overhauled engine. This service, too, is an Airwork "Extra".

P5 To eliminate this type of oil leak in the future, Airwork has incorporated, as an "optional", a specially designed propeller oil transfer system for applicable engines. Phone our Service Department for details. T-Air 5-6000 (Millville).

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# STUKE LOCK

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CLIP-LOCKING TURNBUCKLES

**Associated Aircraft Industries**

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Memphis 12, Tenn.



NOTE: Each of 10 seconds can prove to him 10:30 seconds for lock wedge models.

## TWO POTS

### for missile pressure measurement

Here's a rugged pair—one for low pressures and one for high pressures—that can really take shock and vibration. That's why accurate in-flight missile pressure measurement is their particular specialty.

**THE HIGH-PRESSURE 4-040** comes in gage and absolute models that measure pressure from 500 to 3500 psi. It's a bellend Beardon tube instrument, oil filled and featuring welded construction of 304 stainless steel (no gaskets or O-rings)... full-safe case that takes 5000 psi ...vibration resistance to 35 g's.

**THE LOW-PRESSURE 4-040A** uses a force-summing pressure capsule and a pot to measure absolute, gage, or differential pressures from 0 to 1000 psi. It features a balanced dual flexure pivot for extreme resistance to the effects of shock and vibration.

with provision for matching on the backup for a defective case or tube.

However, this adds to polished size and weight, and adds to the complexity of servicing circuits which in itself tends to reduce some of the gain from redundancy.

#### Reliability Effort Hooled

There is almost the tendency to want to shoot first and ask questions later. "But not in discussing space programs." The space business is too costly to permit us to shoot without first verifying that interim reliability gains have been met. While reliability assurance, like quality control, is often regarded as a bookkeeper function, it is a function which in the space program will be vital. "I think so."

He cautioned that the following is required to prevent space from becoming a multi-billion dollar writing paper.

- Functional simplification of space systems through a number of applications in a reduction in complexity.
- Multiple-redundancy at component and system levels.
- Reliability assurance program which will grade, specify, test and demonstrate reliability progress from the parts level upward.

### RADC Is Operating Language Translator

Washington—Aerobitic language translator with climatic capability at translating Russian scientific and technical literature into English at the rate of 15 words a second is being operated at the Russian Air Development Center, it was disclosed here.

The translator, developed over the last several years by Air Force engineers and several contractors, has been an experimental operation since [see, according to Rep. Donoris Bland (D-La.), chairman of the House Committee on Science and Astronautics, which is looking into machine translation devices].

Present translations are performed on a crack, word-for-word basis but give the sense of the original. The tool will be improved later this year when a word analyzer, which will correct grammar and punctuation. The analyzer is being developed by International Research Machines Corp.

The language translator is limited by the inability to feed the machine Russian at speeds comparable to its receiving ability. A byproduct, for example, working on a Russian keyboard can only produce 40 words a minute at best. This fall, however, Bend-Aerobic, Inc., is expected to deliver to RADC

#### Space Data Capacity

Dayton—Data capacity (bandwidth) of space vehicle telemetry systems is increasing as rapidly that by next year it will be possible to transmit more data, faster, from the moon to the tracking stations at Woomera, Australia, than it can be transmitted from Woomera to Los Angeles, Calif., according to Dr. Henry L. Kuhn, Jr., of the Propulsion Laboratory, Spentling at the recent National Aeronautics Electronics Conference here. Kuhn predicted that space vehicle telemetry bandwidth would reach a separate far lower distance to the mid-1970s, adequate for slow-on, high distance telemetry.

a high-speed print reader, which will boost the input capability to 2,400 words a minute. An earlier electronic print reader made by Battelle-Nichols Research Co. is now in use with the translator.

Key portions of the translator is an IBM-developed auxiliary unit that can store 250,000 Russian English words. As the Russian words are fed into the translator as punched tape, they are converted into electrical signals matched with coded equivalents on the memory unit, and the English translations are read out on an electronic typewriter. Any word not in the library is stored in less than one 50th of a second, according to a House subcommittee report.

The Air Force is only one of a number of government agencies, including the Central Intelligence Agency, the Army and the National Bureau of Standards, which are anticipated to be concerned in machine translation of the Russian language. The U. S. government is currently spending about \$1.5 million on several translations of Russian into English.

Other organizations known to be working on different aspects of machine translation include the Rand Corp., Thompson Radio-Wallbridge, IBM Corp., General Electric, Lockheed of Massachusetts Institute of Technology, Syracuse University, Georgetown University and Air Force's Cambridge Research Center.

Under Basic Air Development Center contract, Spentling University is exploring various of translating English as well as written materials. Design for construction of such a machine will get under way this month, according to the contract.

A delivery as well as the word analyzer is an ongoing development at IBM. A lexical buffer which can store words coming from the dictionary in complete sentences was recently added to the translator.

## this dime-sized SENSING ELEMENT is going places!

It's going into wind tunnels and rocket test stands... into airborne instrumentation... into the same rugged applications where you'll find many of CEC's growing family of unbanded strain-gage pressure transducers. This new spring-gage sensing element assumes linearity and hysteresis of 0.5% of full scale... zero shift of 0.01% and sensitivity shift 0.005% of full scale per degree F.

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**Improved Type 4-028...**  
for measurement to 16,000 psi, new expanded downward into lower range of absolute, gage and differential pressures.  
Belted CEC 1426A-076.



**New version Type 4-087...**  
for gage and absolute pressure measurement to 5,000 psi, new built-in time shock display, capable of measurement to 6 psi.  
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**Brand new Type 4-026...**  
weighs only 6 grams, is less than 1 inch in diameter.  
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You'll want more information on these pot pressure transducers that operate in a range of -65°F to +200°F—with resistance of 5000, 7500, and 10,000 ohms. Write for Bulletin CEC 1004-X27 and 1626-X2, or provide us with your exact requirements for a custom-engineered instrument.

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# G-E Vacuum-Melted Alloys Now Conquer Wide-Gap Brazing Barriers



Wide gap brazing alloy is applied to turbine nozzle assembly. Vases are back welded in position prior to brazing.

## New G-E Wide-Gap Brazing Alloys offer:

- New brazing techniques
- Bridging of joint clearance up to .060 in.
- Faster, more simplified job fabrication
- Extreme cleanliness provided by induction vacuum melting
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- Solution to many problems of distortion and stress relieving associated with fabrication by welds
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Looking for new methods of fabricating high-temperature metals? Nothing can equal G-E vacuum-melted brazing alloy powders for critical applications. All provide the ultimate in exacting chemical control and extreme cleanliness which air-melted alloys cannot match.

Now this latest G-E brazing "breakthrough" of wide-gap alloys extends the use of brazing to a new, wider range of joining applications. Get all the data about G-E vacuum-melted brazing alloys as a short-cut to lower cost manufacturing methods. Write: Metallurgical Products Department of General Electric Company, 1100 E. 8 Mile Blvd., Detroit 22, Michigan.

METALLURGICAL PRODUCTS DEPARTMENT

**GENERAL ELECTRIC**



Insert shows vases completely brazed in spite of gaps. Stains around perimeter of inserts are from slugs.

## IR Velocity/Height Computer Studied

By Barry Miller

Paterson, N. J.—An electronic computer which will employ detection of infrared radiation emitted by the earth to determine the velocity/height ratio of a photo reconnaissance aircraft is at various stages of development. It is currently approaching 1% in better in entering the final stages of development.

Known as a velocity/height (V/H) computer, it is being built in the laboratories of the ACF Electronics Division of ACF Industries, Inc., for Air Force under a \$100,000 study contract from the Wright Air Development Division (AWD Aug. 26 p. 116). Facing a difficult approach, another company, Chicago Naval Industries Inc., working under a parallel WADDD contract, also is developing an infrared speeding V/H computer which is scheduled for comparison with the ACF Industries device. Both computers are to be completed early this summer. V/H computers help solve the problem of blurred film which arises when the speed through a camera is not kept constant in relation to aircraft speed/altitude. The computer determines the velocity/height ratio and then provides signals which can be used to maintain film at proper speed. Normal accuracy of V/H computers, industry sources say, is slightly better than 1% laboratory accuracy; of the ACF computer is better than 1%, according to Ken Ward, a senior physicist on the project.

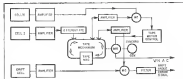
### Altitude Capability

The device is expected to be able to operate at altitudes of 500 to 100,000 ft. with a V/H range of 0.01 radians/sec to 80 radians/sec.

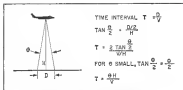
According to ACF, the computer will sense infrared radiation emitted from the earth during day or evening hours and also distinguish cloud cover. The radiation is detected by two thermistor balance detector cells, which are pointed at different angles toward the ground. When one cell senses a variation in radiation, a signal is generated. Followed as control later by an other signal generated in the second detector across the same object.

The time interval between the detection of one ground object by both cells seems to be twice as long as an astronomical technique. The time interval is inversely related to the velocity/height ratio and the presumed information from the system provides a sense which adjusts film speed.

The time interval is extracted from the signals generated by the two cells, ACF explains, by deriving the first



VELOCITY/HEIGHT COMPUTER in development at ACF Industries is shown as block diagram form.



VELOCITY/HEIGHT RATIO is shown to be inversely proportional to the time between detection of ground scenes by two infrared sensor screens.

signal with a variable-speed magnetic tape mechanism. Then, the signal is recorded and played back, the computer uses a delay device proportional to the distance between record and playback heads and reverses with tape velocity. About 100 ft. of tape in a single continuous loop is employed. The tape unit passing through the record and playback heads is viewed in a special magnifier. Used tape can be stored by an erase head.

### Error Signal

An autocorrelation technique which analyzes the average of the integral of the product of the derivative of one signal and the second signal itself gives an error signal which is proportional to error and adjustable to the error in tape speed.

An induction motor functions as the correlation detector—the output of a tachometer coupled to the induction motor controls the speed of the tape through the motor. Because the speed of the tape drive motor is inversely proportional to the time interval between detection by the two cells it is

directly proportional to the velocity/height ratio. Drift angles up to 35 deg. can be corrected with amplifier induced coil ACF says. The time delay between the two cells will vary with drift angle. An additional pickup head on the tape mechanism processes the drift signal provided by the drift coil.

To keep the scene pointed in the same direction as the camera, ACF engineers will mount the cells, reflecting mirror and slapper on the most correct ground of a two-ground still frame platform. This arrangement, they say, will also minimize the effects of structural bending, pitch and roll of the aircraft.

### Increased Range

For increased V/H range, two sets of cells are used with separate pickup heads on the tape mechanism. Each set is guaranteed to that it shares the total distance range. Switching cells and heads requires that the tape mechanism operate over a 50:1 range whereas the distance range of V/H is 1,000:1. Two cells are also selected for drift



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# The Bendix

To reflect our dynamic growth in such fields as electronics, missiles and space, automotive, weapons systems, computers, machine tools, instrumentation, nuclear technology, hydraulics, meteorology, electrical, marine and others, we are dropping "Aviation" from our corporate name on June 1, 1960. We do not wish to convey the impression that our products and skills are limited to the field of aviation alone, although aviation products accounted for billings of \$388,700,000 in 1959.

Today Bendix—through 26 divisions and 16 subsidiary and affiliate companies around the world—serves many fields.

Our success in the rapidly expanding age of aviation has long obscured the fact that the Bendix® automobile starter drive was the company's first major product. Bendix introduced the type of four-wheel brakes that over the years has been used on most makes of cars. Bendix also pioneered automotive power brakes and power steering. Our automotive business in 1959 totaled \$114,300,000.

A notable trend in Bendix' recent history is the utilization of electronics in many of our major fields of activity. These range from automobile radios to

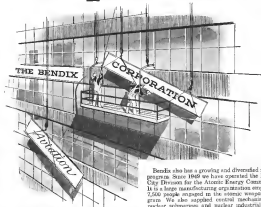
aircraft and industrial communications and automatic flight controls . . . from electronic computers and data processing to numerical tape control systems for machine tools . . . and from transmitters and ship-to-ship telephones to sonic cleaning and underwater sonar detection equipment. Approximately 40% of Bendix products are electronic, including air defense radar which today guards 25 million square miles of the earth's surface.

Missile and space equipment accounted for \$102,000,000 of our total business of \$689,692,212 in 1959, its addition to being the prime contractor for two important missiles, Talos and Eagle, we are also a supplier of components and sub-systems

*diversification as Bendix Aviation Corporation . . .*

*our name to*

# Corporation



for most U. S. missiles. Bendix is likewise taking an active part in Project Mercury and in satellite communications. The first is the program to put a man into space. The second will mark a new era in communications by using a satellite in orbit as a relay station for global radio messages between earth stations and aircraft.

Bendix also has a growing and diversified nuclear program. Since 1949 we have operated the Kennesaw City Division for the Atomic Energy Commission. It is a large manufacturing organization employing 7,500 people engaged in the atomic weapons program. We also supplied control mechanisms for nuclear submarines and nuclear industrial power plants, and we are playing a part in developing the newest U. S. atomic power plants for aircraft, missiles and space vehicles.

Thus, as we drop "Aviation" from our corporate name, but not from our programs, we face a tomorrow where the range of our opportunities is broadening at a breathtaking rate.



*A thousand diversified products*



## ONE-MINUTE SYNCHRO SYSTEM ACCURACY

Electrical two-speed Adcock\* synchro features—

- ACCURACY UNAFFECTED BY THERMAL AND MECHANICAL STRESS
- HIGH SIGNAL-TO-NULL RATIO
- ELIMINATION OF GEAR ERROR FOUND IN MECHANICAL TWO-SPEED SYSTEM
- ADAPTABILITY TO GYRO PICKOFF

Developed to meet need for accurate data transmission with minimum system complexity. Produces two electrical outputs from single shaft, thereby eliminating inaccuracies of two-speed gear system as well as maintenance and maintenance costs of additional unit. The synchro contains two separate sets of windings. One set pre-

dicts the normal signal pattern of one circle of output voltage, while the other produces sinusoidal output, for each rotation of the synchro shaft. Increase in accuracy is very close to the 10-to-1 theoretical maximum, resulting in a system error of  $\pm 1$  minute when and back-to-back with similar units.

\*As in U.S. Pat. 2,977,000

### ADDITIONAL CHARACTERISTICS:

Input voltage (10 volt)	24 volts, 400 cycles, single phase
Input current	100 ma. max.
Input power	2.2 watts max.
Signal to null ratio	100:1
Linearity (10% degree)	0.001

For more detailed information on specific applications, write—

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## FILTER CENTER

► **Stubbommen Blocks** Merges—Proposed merger of the IRE's Professional Group on Automatic and Nonlinear Electronic (PGANE) and the Professional Group on Space Electronics and Telephony (PGSET) is being blocked by a few members of the PGSET administrative committee, despite the fact that chairman Conrad Hoepfer favors the merger. The PGANE administrative committee approved the merger several months ago. Despite PGSET's effort to keep PGANE "out of space," the recent National Automatic Electronic Conference in Dayton, sponsored by PGANE, was dominated by reports on the subject, including technical sessions on space communication systems, managing space systems, radio astronomy, interplanetary environment, electronic propulsion and a forum on space electronics. Nacasa even had one session on telemetry.

► **USAF Meteorology Meeting**—Air Force plans to hold a symposium on the subject of meteorology and meteorology this fall, tentatively scheduled for mid-September. Location and date have not yet been announced.

► **WADD Consolidates Activities**—Under recent reorganization, Wright Air Development Division will consolidate its newly formed Avionics Division's four laboratories as a single building at Wright-Patterson AFB in Dayton. The new location will be Building No. 77, formerly the Weapons Control Laboratory, located on the flight line. The Avionics Division, one of four divisions in the new Directorate of Advanced Systems Technology, will consist of four laboratories: Navigation and Guidance Communications, Communications and Electronic Technology (formerly Electronic Components Laboratory).

► **Improved Passive Communication Satellite**—Several techniques for improving the gain of antennas used in passive communication satellites to reduce the required power of ground transmitters and/or power loss of satellites, were reported in a paper presented by Y. E. Shkilev of Wright Air Development Division at Nacasa. Most effective would be a combination of lens and reflector which could be fabricated using two concentric balloons. The inner surface of the inner balloon would be dielectric and coated with a reflecting material while the space between the two balloons would be impregnated with styrofoam and a special reflective dielectric foam which would serve as a lens.



**MINIATURE** time temperature recorder for jet engines, developed by Avionics, records total time engine operates at maximum temperature and enables jet such engines. Complete engine weight only 54 lb. can be used with a variety of jet engine compressor tips.

## Device Records Number, Time Of Turbojet Over-Temperature

Woodbridge, N. Y.—Mounted time-temperature recorder for jet engines, which not only totals the accumulated time during which an engine has been operated at excessive temperature, but also records the number of instances that over-temperature has occurred, has been developed here by Avionics, Inc.

The new recorder is a smaller, lighter and more versatile version of the time-temperature recorder developed several years ago by Avionics for use on the North American F-100 with General Electric J79-GE-17 and -31 engines (AVR Mar 25, 1967, p. 9). Developed under Wright Air Development Division sponsorship, this recorder will be used on Northrop T-38 jet trainers.

Engineer indicates that the number of instances that a jet engine is operated at excessive temperature as well as the total time at excessive temperatures are both important criteria in determining when an engine should be removed for maintenance or overhaul.

The new Avionics system indicates the number of such events and total time an engine is operated at or above three different temperature levels, for example, 580C, 600C and 700C. However, temperature levels can be tailored to the application.

By substituting transistors for vacuum tubes used in the earlier model, Avionics has been able to cut engine weight by

70% to only 54 lb. Volume has been slashed by 80%. The new model consists of nine main elements, the indicator and the recorder, instead of the original three. Power consumption has been cut from 1.48 to 0.25 to 0.25 to 0.25, which, coupled with the smaller model, has been eliminated.

Company also has increased the upper ambient operating temperature limit from 71C to 115C, it says. The cockpit panel indicator unit has been reduced from a box 10 inches high to a 2 in. disc. The indicator has a computered built-in scale for the lower and extremely high temperature ranges, with an expanded linear scale for the critical 500C to 580C temperature range.

Instrument includes a red "Hot" warning flag which drops into view when engine exceeds normal temperature, and a "Power-On" flag to warn of power failure. The "Hot" warning flag can be designed to drop instantly when an over-temperature occurs, at a time delay can be introduced if desired. Instrument components integral lighting.

Unlike the earlier Avionics time-temperature recorder, which was tailored to the J79 engine, the new model is adaptable to any engine. Company says Avionics is also in 55-15 Northern Blvd., Woodbridge, N. Y.



## BAROMETRIC ALTITUDE CONTROL

Maintains aircraft altitude in automatic flight systems.



This Eclipse-Pioneer precision instrument helps maintain aircraft at a selected altitude in automatic flight. Drawing barometric altitude, it provides directional output signals whenever the aircraft is displaced from the reference. These signals, proportional to the deviation, are power amplified and provide a steady signal to reduce aircraft altitude. With no delay.

## VERTICAL SENSOR

Indicates true vertical position within 4.3 minutes of arc.



Eclipse-Pioneer's Vertical Sensor is a small, 16 1/2" high, lightweight instrument for highly accurate determination of vertical positioning. An air pendulum is suspended in a tube of damping fluid. 90° apart at the bottom of the tube, detect deviation from vertical by sensing movement of the pendulum from center. Output improves from 10 to 100 Hz from vertical, and cross coupling is minimal. Ask for further information.

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Indianapolis, N. J.

## NEW AVIONIC PRODUCTS

## Components & Devices

\* Oscillator clock, Model OC-10, and slave clock, Model SC-10, are two add-ons to Am's 1-mc digital modules. Oscillator clock has crystal oscillator providing 1-mc pulses and frequency -10



vdc  $\pm 10\%$ , 25 millamps. Slave clock requires  $-15$  vdc,  $\pm 10\%$  & 500 current. Computer Control Co., Inc. 985 Concord St., Farmington, Miss.

• **Small storage tube, Type K0918**, is a 1/4-in. diameter tube with maximum length of 914 in. flows tube free to end of 18-ga. conventional low-leakage hose. Vapour gas is high content, low reactivity type; writing speed up to 180,000 cpm; and resolution of 50 lines/in. are possible. Storage time is two months, cost: tube 50 millicoupons and brightness level is 3,000 ft-lamberts at 5 kV/cm. Allen & DuMont Electronics, Inc., 770 Bloomfield Ave., Chilton, N. J.

\* Socket, designed to run with and make possible removal of RCA, tubes available with same run as replacing a tube, can be mounted on printed circuit.



out board and is only 94 mils high. Socket assures low contact resistance and will mate the 18 mil diameter lead wires of the microswitch, according to Eric Jeffers Products, Inc., 56 Route 30, Manassas, N.J.

• **DC/DC Converter, Model PC 1125**, provides 0.1% regulation for 180-line change and 100% load change. Nominal input to transformer-coupled converter is 25 v d.c. and output is 450 v d.c., into 250-watt loads. Dimensions are 3.75 x 4.5 x 5.75 in. Weight is 3.2 lb. Power Instruments Corp., 275 Oregon St., E. I. Instruments Corp.

\*Solens sockets, line of JAN series made by double diffusion process, are available in hermetically sealed metal lead top hat designs (IN578, IN540 and IN547) and in 18 pin, 24 pin designs (IN217, IN214, IN255, IN256). All units meet MIL-E-1 specs. Columbia Electronics Corp. 1018 Saw Mill River Rd., Yonkers, N. Y.

### Test Equipment

• **Digital Timer, Model DET-420**, may be used in computer systems needing precise elapsed timing intervals. This electronic timer has a maximum error of 100 microseconds over the time base error. Several intervals can be preset at



the tracer and any interval can be selected on a special order. Unit requires 115 v, 400 cps single phase and 28 vdc. Output is 26 v at 5 amp maximum current when not timing and during timing interval current drops to 5 amps. Over all dimensions are 7 x 74 x 68 in. Balco Research & Development Laboratories, Inc., 62-10 Woodside Ave., Woodside 77, N.Y.

### Instruments

**Digital re-writers.** Models DT 81 through DT, are designed for software, spreadsheet and word processing. DT 81 is write only, DT 82 is read and write. DT 83 is a read/write model. The last series is capable of seven or eight tracks of read/write on 4 in. tape and is contained in a single 90-lb. package. Adding an auxiliary printed out package allows expansion to 36 read/write tracks on 5 in. tape or 14 to 32 read/write tracks on 1 in. tape. Different heads are available in various formats, including IBM 707 and 704. Operating speeds are adjustable from 1 to 100

ips, with less than 5 milliare start-stop times. Speed control is maintained even during variation in aircraft power supply. Shepherd Industries, Inc., 107 Park Ave., Naples, N. J.



• **Cadpac printer** is designed for burst communications to conserve the bandwidth of any radio transmission link as well as wire line and is capable of printing rates that 30 characters/second on 4 1/2 in. paper tape. The printer is 9 1/2 in. long with a self-contained paper supply and it fits into a standard 3 in. universal instrument case. The printer is designed to sell for less than \$900, according to the company. Potter Instrument Co., Sayreville Blvd., Plainville, N.J.

### Microwave Components

• **Tunable oscillator cavity, Type 9927.** It can be tuned in 2.65 to 3.85 khz range (5 bands) and supplies 100 watts peak, maximum over band (0.001 duty cycle, cos modulated pulse, 1,500 volt peak). Output rise time is less than 50 ns maximum. Using GE type 7886 tube, the oscillator weighs 7 oz., measures 1 in. in diameter by 4 1/2 in. in length not including brackets and output connectors, has an output impedance of 50 ohms. **Ind. Electronics Co., 48 Danbury Rd., Wilton, Conn.**



• Gas tube noise source, T94Q1B, operates in the 265 to 40 kHz range and can produce 18 dB above KTB. Source is testable for CW or pulse operation under typical adverse military environments, has 15 mA operating current, 6.7 v a.c. or d.c. filament voltage and is triggered by 2,000 volts. Tacor, Inc., 15 Marshall St., South Norwalk, Conn.

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The Fisheries Division of Canada (1989)



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COMBAT TB-58 pt bomber trainer enters first flight without carrying external stores yet. View shown just after takeoff.

## TB-58 Trainer Makes Initial Test Flight

El Worth, Tex.—First of four Mach 2 Comstar TB-58A trainer versions of the B-57C bomber has made its first flight here, achieving programmed Mach 1.51 speed at 44,000 ft. Flight crew was Vil Puhli pilot, Earl Galtner and George C. Tate.

The TB-58A program strikes airplanes actually built here for the B-57 test program. The TB-58A will provide transition training and enable tactical

warfare squadron pilots to reinforce their proficiencies for actually any operational bomber version, applying air-releasing techniques and procedures for dropping the external load store. Delivery of initial TB-58A to USAF is scheduled for early July.

Major external difference is additional window area providing improved lateral visibility. Second station also has a 15 in x 24 in overhead canopy.

Interactor or check pilot is located in the second station, seated tandem behind the TB-58A pilot and has a duplicate set of flight controls and instruments. Instrument seat is 5 in higher than the pilot's and is offset 34 in to the right. The TB-58A's third station has provisions for carrying another pilot, who now change seats with the instructor to take the controls during proficiency checks.

INCREASED window area is pointed up in the ground run. Overhead canopy has been provided for the second station.















DORNIER'S second prototype Do-28 is powered by two Lycoming O-540-A1A engines rated at 215 hp each at 2,575 rpm.

## Dornier Raises Do-28 STOL Performance

By Edith Walford

Hannover, Germany—located power and wing area are features of Dornier's second prototype Do-28, shown for the first time at the air show here last month.

The six-seat, four-engine, STOL plane made its first flight on Mar. 20 and was flight-tested at Dornier's Muench-Neuland, infield behind bo-

ing introduced at Hannover, Germany. First prototype Do-28 powered with two 150-hp, Lycoming engines, was announced during last year's Hannover show (AVW June 1, 1989, p. 57) and subsequently demonstrated at the 1989 Paris air show. Since then, Dornier has improved the plane's STOL characteristics by power and wing area increases. Second prototype has two Lycoming O-540-A1A engines rated at

215 hp each at 2,575 rpm. They are mounted on short stub wings attached to the fuselage one on either side of the cockpit and are driven by two-bladed, all-metal Hartzel HC-120XC constant-speed propellers.

The aircraft is a continuation of the single-engine Do-27 series and heavily the same plane except for its four-engine powerplant. In addition, by inserting a modic section in each of the wings, total span has been increased by 3 ft 14 in. to 40 ft 4 in.

Price of the standard model is approximately \$48,710 (DM 195,000), the standard Do-27 is priced at about \$15,710.

### Take Place

The Do-28 is viewed at the business flying market both at home and abroad but particularly at the growing number of companies running charter, taxis or air taxi services of one kind or another. One German company of this kind, Deutsche Verflugh GmbH, Mannheim, established last year has done good business so far with a fleet of Do-27s, but is now planning to extend its services with Do-28-type aircraft that have a higher ceiling and longer range. Taxiflying has indeed around Do-28s for delivery this summer, following delivery of the first low production models to Perles Airways, a South African carrier.

Particular design attention has been given to making the Do-28 suitable for a wide range of uses as well as to in-

creasing the safety margin to the maximum possible.

Standard Do-28 configuration at commercial air passengers including the pilot, two side by side in the cockpit and the remaining four in the cabin behind. In addition, the aircraft is available with several different interior layouts according to its intended purpose.

### Cargo Space

For example, for the transport of small freight the cabin seats can be removed to provide space for about 105 cu. ft. of cargo. An 1,800-lb load can thus be carried over a distance of some 120 mi.

If the load weight less fuel intake and therefore range can be increased accordingly.

Due to the Do-28's good takeoff and landing characteristics, it is also suitable as an ambulance or rescue plane and no major adjustments are required for either of these two duties. The seats in the cabin are simply removed and replaced by two stretchers and the medical attention sits next to the pilot in the cockpit.

Useful load of most of the Do-28 can operate in water between 1,500 and 1,650 lb. Service ceiling is 16,100 ft which makes it well suited for duty in



Do-28's engine have two-bladed, all-metal Hartzel HC-120XC constant speed propellers.



SIX-PLACE Do-28 seats two passengers on each of two facing benches.

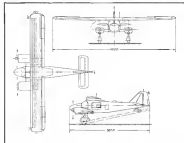
### Do-28 Specifications

Dimensions	
Wing span	46.4 ft.
Length	29.6 ft.
Height without propeller	16.4 ft.
Winged track	13.5 ft.
Wing area	362.5 sq ft.
Cabin length including cockpit and baggage compartment	11.5 ft.
Cabin length without baggage compartment	10.5 ft.
Space for freight	6.9 x 9.4 ft.
Cabin width	43 ft.
Cabin height	4.6 ft.
Base of cabin door	48.1 x 31.5 in.
Size of cockpit door	29.1 x 35.4 in.
Base of baggage compartment door	15.2 x 18.6 in.
Size of baggage compartment	16.5 x 39.4 x 22.6 in.
Baggage compartment capacity	6.6 cu ft.
Wing loading	at 5,110 lb. gross weight 79.9 pd
Power loading	at 5,110 lb. gross weight 30.7 hp/sq ft.
Weights	
Empty weight including instruments, lights heating and trim and full cabin equipment	3,656 lb.
Useful load	1,820 lb.
Maximum gross weight	5,110 lb.

### Do-28 Performance

Climax speed (gross weight at 7500 power)	
at 6,800 ft. (ISA)	162 mph
at 8,075 power at 6,000 ft. (ISA)	132 mph
Maximum speed at sea level	171 mph
Stalling speed at 40° flap 40 deg	50 mph
at 40 deg power, flap 40 deg	46 mph
Rate of climb with 5,110 lb. gross weight 5,000 ft.	2.4 min
8,000 ft.	9 min
9,000 ft.	9 min
Service ceiling with 4,970 lb. gross weight	16,900 ft.
Absolute ceiling with 4,970 lb. gross weight	23,800 ft.
Range without reserves at sea level at 8,075 power,	
at 6,800 ft.	660 statute
at 7,575 power at 6,800 ft.	745 statute
Endurance at 4,970 power	5.45 hr.
Endurance with 5,130 gross weight 5 hr. 10 min. endurance	4.68 hr.
Distance to climb 30 ft.	780 ft.
Landing distance at 4,700 lb. gross weight, zero wind	915 ft.
Distance from 50 ft.	420 ft.

Note: The above performance figures are the results of flight tests conducted by Dornier-Werke with the Do-28 in cruise conditions. Figures will vary the manufacturer states with individual aircraft and various before affecting flight performance.



THREE-VIEW of Do-28 shows rectangular all-metal wing with constant chord section.



WHAT WAS SINGER DOING AT FORT HUACHUCA? At this important electronic proving ground of the U. S. Army Signal Corps, Singer supplied lightweight high resolution infrared equipment capable of installation in all airborne vehicles. Representatives of the Singer Military Products Division work closely with engineering and development teams of defense establishments throughout the country. A division of The Singer Manufacturing Company, SMPD is composed of Singer-Bridgeport, Dunbar Manufacturing Company and HRR-Singer.

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PHOTO BY THE NEW YORK TIMES PHOTOGRAPHY

exterior dimensions. Range is 740 mi. when cruising at a speed of 112 mph, and at a altitude of 5,500 ft. Maximum takeoff weight is 5,137 lb. Basic fuselage is designed as a mono coque structure, the fuselage outer section as a four-stringer open front and stringer structure giving the fuselage skin very large sections. Fuselage nose is a plastic shell. The stub wings forming the engine nacel housing gear support are bolted to frames of the lower fuselage shell and can be disassembled.

There is a large upward-opening and jettisonable crew door on either side of the fuselage and the cabin has a wide, transparent door also opening upward. Windshield and large dorsal Plexiglas window also, both crew and passenger good, all round, visibility. Useful cabin area is approximately 85 cu ft.

Dimensions of the loading door opening are 41.3 x 31.5 in.

The baggage compartment behind the cabin can accommodate a load of 17.6 cu ft. It is accessible from outside and can be loaded. For small load baggage, space is provided immediately behind the main cabin seats.

#### Wing Design

The rectangular main wing is an all-metal design with a constant airfoil section over the entire span. The center section of the three-piece wing is bolted to the fuselage, the outer sections to the center section.

Loading edge with a fixed slot is attached to the front spar of the sheet metal tension box, the trailing edge structure is attached to the aft spar. The leading edge slot extends continuously across the full span and is constructed in several sections to facilitate maintenance and repair. For the same reason the wing tips are attached to the wings by detachable bolt connections.

Wing flaps and ailerons are designed as demountable, hinged, removable. They are hinged onto a fixed spar within the aileron section and the whole easily actuated. Ailerons are internally and externally balanced.

Vertical fin and horizontal stabilizer are sheet-plated, all metal structures. The fabric-covered ailerons and elevator are aerodynamically balanced and detachable. The horizontal stabilizer, adjustable in flight, can be mounted or dismounted without touching the horizontal fin.

#### Flight Controls

All controls are operated by a conventional cable and pulley system. If required, the aircraft can easily and quickly be fitted with dual controls. Two wheel for setting the horizontal stabilizer is located between the two forward seats. A rudder trim control is



#### Tempo II, On Mark Marksmen B-26 Conversions

Formered Tempo II B-26 conversion to a 18 passenger executive transport (Model) is our early undergoing Federal Aviation Agency certification tests at Miami, Fla. The aircraft (AW No. 34, p. 187) is manufactured by L. B. South Aircraft Corp. Below is the present Marksmen conversion, built by De Mark Engineering Co., Van Nuys, Calif. Marksmen carries 16 passengers, plus pilot and copilot, and will make its first flight in June. Basic price is \$217,450, range is 1,200 mi. with reserves. Remanufactured fuselage has full extensive airframe done with all wing spar reinforced, DCF-type cabin modules and with toilet facilities. First also built, remanufactured Marksmen conversion.



also provided and can be operated from the pilot's seat in the case of single-engine flight. The wing flaps are operated by a geared hand levered controls in front of the two forward seats. They can be deflected by various intermediate settings up to 45 deg.

#### Landing Gear

The fixed landing gear presented on the stub wings consists of two conventional oleo legs provided with shock-absorbing fluid. The wheels are mounted in a fork and are faired. Wheel brakes are controlled by foot pedals from the cockpit.

The tail assembly wheel consists of an swivel wheeling 360 deg. with spring strut and automatic steering. For towing or being towed, the towing bar of the tail wheel axle is fitted with two different attachments.

Two twin main tanks contain 51 gal of fuel each, two auxiliary tanks on the T-2 gal of fuel each, so that total

fuel carried amounts to 108.6 gal. The main powerplants are statically mounted on tubular support brackets attached to the floor at four points. The engine cooling ducts, consisting of four panels, the two side panels are fitted with quick-release brackets. The upper and lower panels are detachable by a latch.

As from the carburetor is ducted to the engine through a filter which can easily be removed. Air can be heated by bypassing along the exhaust tubes.

#### Heating and Ventilation

The plane is fitted with a color air-conditioning system. Air is heated in heat exchangers by both engines and warm air cold air can also be blown by a fan in the cockpit against the windshield to prevent frosting.

Most of the flight and engine instruments are pneumatic, but electrical instruments can be fitted as optional extras.



## Eastern Stainless meets deadline on rework job at Douglas Aircraft

Planes were flown to the Douglas plant where passenger floors and lightweight floor beams were entirely replaced with new rugged structure to withstand heavy cargo loads. On each plane, both passenger door openings were enlarged to form cargo doors. Part of this assembly-line operation involved Type 347 stainless steel which Douglas needed in a hurry. Eastern was asked to supply the required stainless on a rush basis.

Given top priority at Eastern Stainless, the order arrived at Douglas within the allotted time enabling the project to proceed on schedule.

This is another example of the importance of stainless steel to West Coast companies—and the service Eastern Stainless offers the aircraft, missile and rocket industry in that area. If your problem is one of tonnage, time or technical advice, talk to Eastern Stainless (or one of their good West Coast Distributors).

**ES EASTERN STAINLESS STEEL**  
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## PRIVATE LINES

Tenets Flying Services has been formed by a number of large and medium-size Netherlands companies, mostly textile mills, in a cooperative which will own and operate aircraft bus routes abroad for joint use of personnel of those concerns. A *Compagnie de Huisland Drie* has been purchased to start the operation and plans are to expand the fleet in the future.

Export sales of more than \$1 million for March are reported by *Consolidated Aircraft Co., Wichita, Kan.* The largest sales volume to foreign markets is in a single month in its history. Total export volume in March totaled \$9.4 million and spare parts valued at \$1,185,000 to exceed the previous record month of February, 1967, when sales totaled \$9,000,000. Latin American countries took 39 aircraft, Canada 18, Australia 17, Puerto Rico 5 and South Africa 5. Argentina took 13 units. Commercial Export Sales Manager M. P. McInerney believes that *Consolidated* foreign sales volume should well exceed last year's \$96 million valued at \$4,565,000.

Delivery of *Boeing 47G-3* helicopter supercharged utility helicopter has been made to *General American Helicopters, Inc., Los Angeles, Calif.*, which will operate the aircraft on a charter basis. *Boeing* reports that it had a backlog for 17 of this new model before ship one came off its *Boeing Tex.* production line.

*Harte Corp.* has discontinued its *Rent-A-Plane Service, Inc.* operation which started in May, 1957, by forming plane rental operation. *Harte* said it was terminating the service "in view of the apparent unsuitability of federal controls" on *Rent-A-Plane's* activities. *CAD* has previously indicated that *Harte* was operating as an indirect air carrier.

*Airbus Power Supply, Inc., Dallas, Calif.*, has formed Aviation Agency approach to build modified *F4U-1* and *Waco* R955 engines, which it has in production, in all two-engine *Boeing* aircraft which have passed approval for installation of standard R955. *APS* says its modification increases climb and single engine performance by saving weight. Power ratio is 12 to 1.

*Caroline Aero Service, Ltd.*, will conduct an 18 month survey of 100,000 sq. ft. of Turkey under an \$870,000 contract from the Turkish government. Survey aircraft will carry *Cadillac* type investigators and will maintain a record of special design. Possible construction sites are being sought.

## Civil Aircraft, Engine Shipments

Shipments by Month Manufacturing Complete Civilian Aircraft and Engines for Civilian Aircraft

Item	February 1968	Jan.-Feb. 1968
<b>Complete aircraft total shipment weight</b> (Pounds)	3,847,000	4,716,000
<b>By weight of plane:</b>		
Under 2,000 lb. aircraft weight (Pounds)	445,700	1,200,000
2,000 lb. aircraft weight and over (Pounds)	3,401,300	3,516,000
<b>By number of planes:</b>		
1- and 2-place (Pounds)	290,000	1,440,700
3- and 4-place (Pounds)	1,447,500	3,444,300
Over 5-place (Pounds)		
<b>By total retail horsepower, all airplanes</b> (Horsepower)	445,000	1,200,000
Under 100 hp (Horsepower)	445,000	1,200,000
100-200 hp (Horsepower)	5,000,000	3,400,000
Over 200 hp and over (Horsepower)		
<b>Aircraft engines:</b>		
Engines (Shipment)	1,200	2,000
Gas turbines (Shipment)	30	10
<b>Aircraft engines:</b>		
Engines (Total horsepower)	337,000	445,000
Gas turbines (Total horsepower)	30	10
<b>Complete aircraft</b> (Shipment)	600	1,000
<b>By weight of plane:</b>		
Under 2,000 lb. aircraft weight (Shipment)	40	1,000
2,000 lb. aircraft weight and over (Shipment)	40	70
<b>By number of planes:</b>		
1- and 2-place (Shipment)	100	1,400
3- and 4-place (Shipment)	60	100
Over 5-place (Shipment)		
<b>By total retail horsepower, all airplanes</b> (Shipment)	700	1,200
Under 100 hp (Shipment)	700	1,200
100-200 hp (Shipment)	100	100
Over 200 hp and over (Shipment)		
<b>Value of shipments of complete aircraft and parts, total</b> (Dollars)	124,417,000	230,200,000
Aircraft total (Dollars)	118,770,000	201,000,000
Under 2,000 lb. aircraft weight (Dollars)	16,770,000	37,000,000
2,000 lb. aircraft weight and over (Dollars)	102,000,000	164,000,000
<b>Aircraft parts</b> (Dollars)	11,470,000	31,200,000
<b>Value of shipments of aircraft engines and parts, total</b> (Dollars)	30,100,000	31,200,000
Aircraft engines (Dollars)	2,400,000	5,100,000
Gas turbines (Dollars)	10	10
Engine parts (Dollars)	32,000,000	26,100,000
<b>Weighted value (Shipment 2,000 lb. aircraft weight and over)</b> (Dollars)	400	

2 = Modified to avoid disclosing figures for individual companies. Data prepared by Bureau of the Census, Industry Division, Machinery & Equipment, compiled from 25 companies operating 25 plants producing complete aircraft and engine aircraft components operating seven plants.





### TF-33 Turboprops Mounted on B-52H

Cooling configuration of new Pratt & Whitney TF-33 17,000-shp. turbo-prop engines on Boeing B-52H mainline platforms is detailed in this view of installation on the latest model Superfortresses at the company's Wichita, Kan., Division. The new TF-33 will provide a substantial power increase to the B-52H over previous models, an addition to 10% engine in-take flow, initial flights of turboprop-powered B-52H are scheduled for mid-summer with production models delivered to SAC in 1964.

shown. This failed to reveal any gross failure or defect in the structure or the firing control circuit. It was established that the flap was retracted on impact and that no structural operation had taken place prior to the test sequence.

The maintenance was locked up. There were indications that all the engines were running under some degree of power when the aircraft struck the ground. Subsequent repair examination of the first engine revealed nothing of an extraordinary nature with respect to either their mechanical or operational state.

### Propeller Assembly

Examination of the propeller in the maintenance shed failed to reveal any evidence to indicate that any assembly was other than at a positive pitch within the cross wind speed range. A broad examination of the blade pitch angle on impact is as follows:

No. 1 propeller between 35 deg. and 50 deg. positive pitch; No. 2 propeller between 25 deg. and 35 deg. positive pitch; No. 3 propeller 35 deg. positive pitch; No. 4 propeller 35 deg. positive pitch. A few pieces of paper which were also found as part of the Flight Test Observer's handwriting log was recovered from the accident site after most of the wreckage had been removed to Filton. With the aid of various photographs, it was possible to decipher the log (see below).

The heading of the log indicates that the notes are concerned with the accident flight and it indicates that there existed an order sheet of the log covering the subject part of the flight. This was not seen and an interpretation of the first line of the log

applied at the same time as the speed of 100 kt. However, if it is a negative tone there is the possibility that a speed higher than 100 kt. applied when the Mach reading was greater than 0.75.

The fourth line of the log probably refers to the emergency switch in the cockpit which operated the Automatic Observer (AO) engine continuously and the other, smaller number of the reading appears to be from 80% to 100% when which the emergency switch was put to "OFF".

The next line indicates that at 1150 kt., engine was set for Filton and that it was the intention to extend on the Automatic Observer (AO) the operation of all loss population to normal pitch during the last run. The Flight Test Observer had noted that the correct number of the engine re-rotation the propeller should be 0.075 (last line of the log).

Referenced to the speed recorded in this log, the following are limitations for the aircraft normal operating limit speed—735 kt. IAS and 0.80 Mach; no sustained flight during speed—104 kt. equivalent air speed and 0.30 Mach.

### Forwarder Examination

It was decided after consultation, that the wreckage should be sent to the Structural Department, Royal Aircraft Establishment, Farnborough, where a partial examination and a detailed examination could be taken place. The examination was conducted on the first engine with the research engineer and ground control notes. The fact that the aircraft had exceeded its speed limitations on the subject flight was particularly borne in mind.

The extensive disintegration of the aircraft necessitated partial reconstruction of the wings, three engine nacelles and flaps, and the tailplane. No attempt was made to reconstruct the fuselage. The conditions shown from the subsequent examination were that the tailplane wing had been disintegrated progressively from tip to root by failure spread and backward. The port wing had been crushed in spans between the tip and the root and the starboard tailplane had been damaged in a

moment similar to those respective wings.

The main control surfaces, flap tabs and trimmer controls were not to the control position at the time of impact and there was no evidence that any hydraulic control had been inadvertently operated in flight. The nature of the damage to the wing indicated that it had struck the ground in a violent angle of attack and had contacted about that angle, with shattering failure over the ground, port wing leading and heading up in the process. No evidence was found of any physical defect or failure in the aircraft or its environment.

The examination was then extended to include the electrical and autopilot systems. Signals from the cockpit of the aircraft were electric, solenoid and solenoid connections to be investigated. A system of dual lines and push-pull rods connect the solenoids to their respective autopilot controls. Each push-pull rod is equipped with a tensioned spring, the deflection of which operates an electrical contact switch connected to the electric magnetic circuit of the associated solenoid. The push-pull rods are called lock limiting levers. A shear screw is machined into each of the solenoid shafts so that if a steel coil selection gear turns the screw can fail in order to free the control circuit.

### Link Inspection

Inspection of the first limiting link of the solenoid control circuit showed that the link which operates the control switch had made a pattern of deformation as a direct consequence of being subjected to a sharp impact of the shaft when the force limiting link. From an examination of the solenoid control circuit, it was concluded that the shear screw had failed in tension before it released damage from ground impact. An identical test specimen which was otherwise subjected to a test was failing showed the same type of failure. It was established that the solenoid power switch was in the "OFF" position at the moment of impact and that the examination of individual components subjected the two rivets and another associated rivet were missing, though not under electrical power at that moment.

This suggests that the two rivets 'were' after having been twisted off a short time before the accident occurred. No direct evidence was found to indicate that the solenoid control switch had remained as engaged after the autopilot had been switched off.

The conclusion of the Structural Department on this examination of the wreckage is as follows:

• From the examination of the wreckage of the main G-ANCA, evidence has been discovered which shows that the autopilot system should have been disengaged before the crash in a manner consistent with failure of the clutch clutch to disengage, if through the separate switch had been engaged.

• It is considered that the lack of direct

\*Note: Although during the test the main line was not to fail by means of a shear screw, it was not found that 100 kt. is applied to the control circuit, there is no evidence seen of the failure occurring in the air.



At Bell Helicopter, Fort Worth, Texas...

**traveling spray booths**  
help cut painting time 80%

"Helicopters are difficult to move down an assembly line so we decided to move the assembly line past the helicopters," states the paint shop foreman at Bell Helicopter, Fort Worth, Texas.

### Two traveling spray booths

With the help of Bell personnel, Binks spray booth engineers developed two giant traveling spray booths mounted on rails. Each carries with it all the equipment needed for spray painting, from spray guns to air compressors. After a helicopter is painted, the booth moves down the line.

### Close air control on ceiling

No sand exhaust stack could be used with a traveling booth, so Binks engineers recommended

the use of water-wash spray booths. The water-wash system completely traps overspray paint pigments and fumes so that air exhausted through bouvered ducts in the room cooling is clean. There is no pipe connection between the exhaust stack and the ducts.

### Complete equipment line and design help available

Whether you need a for a special custom installation of the type reported here or an integrated system using standard components, it will pay you to check first with Binks.

### Details in Bulletin 975

Ask your Binks Branch Office for a copy, or write direct.

Ask about our spray painting school  
Open to all...NO TUITION...covers all phases.

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Aerob G-ANCA					
Flight No 248		Sheet 2			
Foot		A.U.F.	B.	C.	
Time	Control	Fusee Speed	ACP	Dist	
1151			Ap = 7.9	2760	
	0070		at 300 Kts.		
			very severe buffeting		SE > 75
	0071.17		En Go		
	0075		Eng lower will record landing on all 4 engines		

INVESTIGATORS requested a review of the test observer's log by attached photographs.





JUNE 20, 1960 Aviation Week



8-7-60-60

ART BY  
DANIELA S. B. B. B.  
AIR LAUNCH BALLISTIC MISSILE

# SAC IN TRANSITION

A Special  
Aviation Week  
Report on the  
Strategic Air Command's  
Transition  
into the  
Aerospace Age

The changing role of the Strategic Air Command in the national defense picture will be featured on June 20th in a special 26-page report prepared by AVIATION WEEK editors with on-the-spot coverage of the SAC Command—The nation's shield against aggression.

This exclusive report will be published in answer to the growing requirement for an improved national understanding of SAC's changing role as the primary deterrent force guarding national security. The annual SAC issue will be devoted to this message which is today's most challenging subject.

The Strategic Air Command's deterrent posture has undergone complex and fundamental changes in its transition to a Strategic Aero-Space Command—with its formidable bomber fleet soon to be reinforced by intercontinental ballistic missiles operationally deployed to instantly counter any aggressive action.

The transition of SAC is one of the most rapid and exciting events in the history of our nation and its defense. What SAC needs, what has already and the weapon systems to be employed in the immediate future will be key subjects included in this first-time technical evaluation. The impact of new technologies and weapon systems has changed the entire defense concept and the response of SAC to these new requirements has been effective and positive.

AVIATION WEEK editorial teams are now engaged in the compilation of the new SAC story—one that will generate world-wide readership. This issue, "SAC In Transition," offers manufacturers and suppliers of the aerospace industry an unusual opportunity to advertise and identify their role in the national defense effort.

**Aviation Week**  
... Space Technology

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# NASA's

## 2nd, 3rd, 4th generation space rockets

To go vastly greater distances...  
to send heavier payloads.

NASA scientists and engineers are working on the Centaur, Saturn and the Nova type vehicle. As the course of scientific progress approaches the horizon, these advanced rocket boosters may bring significant breakthroughs in space exploration.

**CENTAUR**—the first rocket booster to be fueled with liquid hydrogen—will enable NASA scientists and engineers to put four-ton payloads into 500-mile orbits around the earth.

**SATURN**—initiated by Defense Department and now transferred to NASA, the 1.5 million pound thrust booster will place 15-ton payloads in orbit. Such a payload could be a manned space observatory.

**NOVA TYPE**—a cluster of single chamber 1.5 million pound thrust engines now being developed to launch multi-ton space stations or to send manned expeditions to the moon.

### Scientists and Engineers:

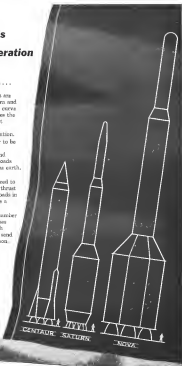
Conquer opportunities of NASA are as unlimited as the scope of our organization.

Please address your inquiries to the Personnel Director in the following sections where openings exist or are anticipated:

**NASA's Goddard Space Flight Center**  
Greenbelt, Md. 20771

**NASA's Ames Research Center**  
Moffett, California

**NASA's Marshall Space Flight Center**  
Huntsville, Alabama



**NASA**

National Aeronautics and Space Administration

leading back slash can result from crash impact damage with the clutch disengaged. To support this then caused out bolt which showed the sensorator shaft in a manner similar to that of the accident aircraft and which produced approximately full rotor rotation.

These impact on the bolt caused out con clutch as follows:

The bolt as caused out, later shown that the sensorator mounting support shaft can be sheared and full rotor rotation can be produced on the force limiting bolt. This due to impact damage on other component as extraneous with the sensorator (clutch clutch disengaged).

The accident has involved a prolonged consideration of nature of considerable technical complexity and the timing and of numerous facts and pending questions by a large number of specialists.

Although on a small scale, considerable number of people (most factors can be, this noted, the cause of the accident more still remain a matter of speculation. Considering the accident as a whole, the balance of evidence is not inconsistent with conclusion on the subject although there is no conclusive proof of the.

On the subject flight, the aircraft carried a quantity of light recording equipment but that was destroyed by the force of impact and no useful information could be obtained from any of the recording made.

The equipment is not attached to determine the type of shock loading to which it was subjected, but a suitable de-quad crash recorder might well have been attached. The aircraft was not fitted with one.

### Conclusions:

(1) The documentation of the accident was in order.

(2) The captain and the cockpit operator were properly briefed. The cockpit was a modified K-14 which had no fuel and fuel tank lower. The flight recorder held no means to fly in that capacity but was also quickly trained to carry out a flight trip over the ocean.

(3) A detailed examination of the aircraft and its main control system revealed no evidence of possible failure.

(4) The crew members of the line-up and their respective positions indicated that there were functioning aircraft.

(5) A design fault in the electrical circuit of the autopilot flight system had the effect of changing the switching arrangement of the sensorator clutch to a single pole operation when double pole was intended.

(6) There is no positive proof that the autopilot system clutch failed to disengage when the appropriate switches were open.

### Opinion

The accident was the result of the crash developing a very sharp deceleration, to the point where the pilot was unable to control. The reason for this could not be determined, but the possibility that it occurred as the result of malfunctioning of the autopilot cannot be dismissed.

F. C. TUCKER  
Chief Inspector of Accidents



## WHEELS DOWN?

...he's sure with the Aerotec AS-100



Weather closing in... air traffic heavy. During a landing approach under difficult conditions, the confidence given by this switch can be of vital importance. If the wheels are not down and locked when the aircraft reaches a predetermined clearance altitude and altitude, the pilot knows a warning "beep" in his earphones. Manual radio communication continues without interference.

The AS-200 has been fully proven. It qualifies for all military and commercial aircraft, and is currently in use on the North American F-100 and T-30, and Republic F-105. The MJ-3, a modified version of the AS-100, is used on the Lockheed F-104. Please or write Aerotec for more information on the AS-100 and other aircraft switches and equipment.



**AEROTEC INDUSTRIES, INC.**

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## EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY IN ELECTRONICS

Lockheed Missiles and Space Division has made significant contributions in electronics in such areas as: computer development, telemetry, radar and data links, time-of-flight and instrumentation, antennas and electromagnetic propagation, and reflection, ferroelectric and MASER research, data selection and analysis, solid state electronics, including photovoltaic devices, electrochemistry, infrared optics, FM-FM data systems, PAM-PCM data links, and logical design.

Special emphasis is being attached to the research, design and development of improved military electronics systems for communications, including new methods of data transmission, reception and storage. Forwarding work is also being conducted in space vehicle force concepts, DC-AC conversion, non-gyro guidance systems. Studies in oceanography include underwater communication and navigation, and natural phenomena and military aspects of the deep sea.

Lockheed's programs reach far into the future and deal with unknown environments. It is a rewarding field and one that outstanding scientists and engineers are invited to share. If you are experienced in any of the above areas, or in related work, we invite your inquiry. Please write: Research and Development Staff, Dept. E-17-B, 962 W. 21 Century Road, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

**Lockheed**

## MISSILES AND SPACE DIVISION

System Manager for the Navy POLARIS FBM, the Air Force AGENA Satellite in the DISCOVERER, MIDAS and SAMOS Programs  
Air Force X-7 and Army KINGFISHER

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SALT LAKE CITY, UTAH • ALBUQUERQUE, NEW MEXICO • HAWAII

## WHO'S WHERE

(Continued from page 13)

### Changes

Dr. Charles F. Gell, chief of life sciences, Administrator, Division of Chance, Wright Laboratory, Dayton, Ohio.  
Thomas Peters, director of government programs, U.S. Industries, Inc., New York City.

Fred Morrison, head of the advanced Semiconductor project, Motorola's Western Military Electronics Center, Phoenix.  
John C. Home, assistant district manager of Thompson Radio Broadcasting's Dallas (Texas) office.

Joseph R. Currey, Jr., director of marketing, Tele-Radio Corp., Division of Tele-Recording Corp., Los Angeles, Calif.  
Archie F. Stuart, chief engineer, Auburn, Louisiana Department.  
Lippmann Department, Haystack Systems Co., a division of Hirsch Corp., Washington, D.C.

Military Products Division of Hoffman Electronics Corp., Los Angeles, Calif. has announced the following appointments:  
Dr. John J. Myers, director of engineering.  
Philip J. Koenig, director of research and operations.  
Frederick J. Sankel, director of Systems Development.  
Lawrence M. Strickland, director of Instrument Department.  
Dr. A. L. Fierst, technical advisor to the general manager and he continues as director of reliability.

Kenneth Young Knight, manager of the newly formed manufacturing services and control department at Hughes Aircraft Co.'s Ground Systems Group, Fullerton, Calif. Older Ground Systems Group appointments: Robert V. K. Brown, manager, Manufacturing and Parts Service Division.  
Robert M. Swales, manager, Radar Systems Department of the radar laboratory.

Robert Helms, program manager for the radar laboratory portion of the Los Angeles Division project for the Marine Corps, Fullerton, Calif. William A. Bunker, commander of the Marine Corps and communications program manager of the California Division.  
Stanley G. Folan, general sales manager, The Perkin Elmer Co., New Britain, Conn.

A. Clyde Fleckner, manager of administrative services, Tactical Weapon Systems Division of the Air Force, Division of Paul Weber Co., Newport Beach, Calif.  
Defense Systems Department of General Electric Co. has opened a district office in Louisville, Mo., and William S. Henry has been appointed district manager.

Lawrence J. Gile, director of commercial sales, and Edward G. Gensky, director of military sales, Barton Rodgers, Inc., Cincinnati, Ohio.  
Robert F. Wiggins, senior air transport control, Ramona, La. Louis.

The Perkin Elmer Division has announced the following appointments: Eric Renshaw, director of engine production.  
John Deane, director of quality control, research and development.  
Gill.

Harold F. York, director of plant and programs, Systems Development Corp., Santa Monica, Calif.  
E. J. Lofgren, manager of business program marketing section, General Electric Co.'s Motor and Space Vehicle Department, Philadelphia, Pa.

### Engineers

## RCA HAS SEVERAL UNUSUAL OPPORTUNITIES IN ADVANCED MAGNETIC RECORDING

### Openings On Management and D & D Levels

A continuing increase of activities in advanced defense systems has created several openings for engineers who are active in developing a number of highly sophisticated magnetic recording devices. These devices will be used in data processing, digital communications, and detection and correlation applications, and require, for their development, engineering ability and imagination of the highest magnitude.

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Transistor Circuits	Tube Drivers
Indexing Equipment	Magnetic Drums
Systems Engineering	Scramblers
Magnetic Recording Instrumentation	

If you qualify, and are interested in furthering your career by taking part in the many advanced projects at RCA, you may arrange a confidential interview by calling collect or sending a resume to:

Mr. J. A. Miller, Dept. AM-50  
RCA Professional Employment  
Building 10-1  
Columbia, New Jersey  
WD-6666 4-3200

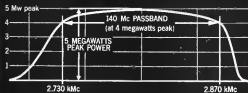


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